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EDITORIAL NOTES.

Suggested Joint Gas and Electricity Conference on the Coal Question.

THE time has arrived for action of a more effective order than there has yet been in regard to the pressing coal question. There has been much parleying round about the matter, which is one of extreme gravity, not only in relation to work connected with the war, but to the industries upon which the community depends, and which are the real productive sources of the finance needed for carrying on the war and the ordinary services of the country. But the Government and their departments are treating this coal question, or rather questions, for there is more than one, as though they were not of present fundamental importance, but something of a secondary character which can well wait for treatment upon their convenience. If this is not the attitude of those who alone can take effective measures for improving matters, then there has not been contradiction by any outward sign of movement on the part of the Government or the Board of Trade, or of results from any private action that they may have taken. In short, passivity seems to be the dominating policy.

What is the position? There have been pleasant conferences with the President of the Board of Trade, and the Parliamentary Secretary to the Board, on the whole subject—from coal supply and prices to transport and distribution. Since "Good day" was said, nothing more has been heard as to whether the Government or the Board of Trade are exercising their powers to assuage the serious prevailing conditions, which, if they are not quickly modified, will inflict still more grievous injury on the whole country, and cripple its internal power and resources just when they want to be maintained at the highest possible level of potency. The deputations, deeply concerned as their members were, apparently had not sufficient stimulating power; or were the interviews granted merely as an act of courtesy? Silence and inaction make the answer doubtful. Meanwhile the country has had placed before it the report of the Committee appointed by the Board of Trade to consider the question of the causes of the high prices of coal. This report confirms in every particular the arguments of, and the position taken up by, the representatives of the gas and electricity industries. But the Government does not appear to be in any hurry to act on the recommendations of the Committee, or substitute them by other effective action. Yet it must be manifest to every intelligent person who reads the disinterested conclusions of the Committee that, unless something of a controlling nature is put into force, the country will continue to be victimized by arbitrary prices for coal and freights, and that, unless something of an accelerating character is brought about in relation to distribution, the country will be denuded of its coal stocks, and next winter will see its industries and its lighting, heating, and power services placed in jeopardy, and the conditions as to price and supply made much worse than those that have ruled during the last few months. The outlook, in the face of inaction, is serious indeed; but the apparent want of appreciation of this in high places is a most remarkable phase of the situation.

The existing position of affairs is aggravated by the menace of prospective trouble. A momentous question has been raised by the claim of the miners for a 20 per cent. war bonus; and both sides seem inclined to handle the matter in a somewhat rasping manner. In formulating their claim, the miners have sought a national conference with the owners. The coal owners' reply is that there are properly constituted authorities in every coal area for dealing with questions affecting remuneration; and that this is a question that cannot be treated on a national basis. To this the miners retort that the bonus applies to war conditions, that these conditions exist throughout the country, and therefore the bonus can be, and must be, treated as having general application. The Miners' Federation are having a conference this week to consider the attitude of the masters. The relative positions look rather uncompromising. In South Wales, the owners have offered a war bonus of 10 per cent., which agrees with the maximum that is being paid to workers receiving wages on the lower scale in other industries. The men have replied by handing in their legal three months' notice to terminate their agreements. The Scottish miners are also asking for a new wages agreement; and they, too, have handed in their three months' notices. The position has not by any means an agreeable appearance. It is monstrous that there should be all this trouble when at home there should be peace and every man's shoulder at the wheel in order to hasten the day of victory for this country and its Allies. Instead of this, "What picking and profit "can I get out of the current conditions?" seems to be the question constantly uppermost in the minds of some men, and the principal animating force in their business or working conduct. There is unrest, too, among the railway men; and they also desire a conference on the subject of an advance of wages.

The coal owners collectively (with exceptions in places) are not a whit better than the miners. It is grab, grab, grab all the time, and under conditions which, for the information of the country, the Board of Trade Coal Committee set forth in their report. The Midland coal owners, according to a resolution passed by them and published in "The Times," are treating the position with an undignified levity, if the terms of the resolution have been properly reported. It seems that they want to set up a general guide for increasing gas coal prices for the coming contract season, and the humorous part is the amount of the advance that they think will show great consideration on the part of the coal owners towards the gas industry in the prevailing circumstances. The resolution (which, we suppose, has been circulated among the coal owners of the country) is as follows: "It is "necessary, having regard to the circumstances of the "present position of the country, that the coal owners should "use their best endeavours to control advances in the price "of gas coal, so as to keep the figure within reasonable "limits, and consistent with the circumstances of production. "It is suggested that the advance on expiring contracts "should be from 5s. to 6s. per ton." What about the Coal Committee's report, and the calculation (a calculation confirmed by coal owners who are not prepared to supplement their profits by taking advantage of the country's present troubles) as to the increased costs that have been brought upon the production of coal by the war? The shilling or so additional cost per ton at the mine, "on a high estimate," does not confirm the view that, instead of desiring to plunder the gas industry, and getting other coal owners to do the same, the Midland coal owners—moved by condescension towards the gas industry, and considering the extra indispensable part it is taking in the country's service just now—are willing to let it off lightly under coming contracts. Their disinterested appeal to other coal owners to keep the additional figure "within reasonable limits, and "consistent with the circumstances of production," has its laughable side, for it is a confession of belief in the capacity of themselves and their fellows to, without putting strong restraint on themselves, make the extra price one that is outside "reasonable limits," and not "consistent with the "circumstances of production." Some new contracts have already been made for Durham coal at from 1s. 9d. to 3s. per ton in excess of last contract prices, according to what those last prices were. Some of these contracts were settled just before the recent upward rush of retail coal prices. But the advances named do not support the Midland coal owners' views, which, exclusive of all additional transit expenses, would mean an extra cost of 5d. or 6d. per 1000 cubic feet of gas. Those responsible for the management of gas undertakings do not at all object to the coal owners recouping themselves legitimate extra costs,

but they do demur to paying the super-profits the coal owners are trying to exact owing to the opportunity provided by the war, and which must come out of the pockets of a public already heavily loaded with increased costs, and likely to be more so.

However, taking into consideration the lethargy in high quarters over current and prospective coal conditions, it is time that some more effective steps were taken to make the voices heard of the gas and electricity industries; for it is no use blinking the fact that conditions are accumulating (some of which could be obviated by proper regulation) which will be serious and disastrous, if allowed to continue, in the not distant future. How are the two industries to make their voices heard? A suggestion comes from the conference of the Manchester District Institution of Gas Engineers last week, on which occasion confirmation was given to a recommendation of the Lancashire Commercial Gas Section that a large joint meeting of representatives of the gas and electric industries should be held in London, in order to bring their combined pressure to bear in the right quarters. Both industries are considerable users of coal—the gas industry the larger—and both carry on important public services. They have a common interest in this matter; and it is one in which union must mean strength. We do not know what steps it is proposed should be taken to bring about this national meeting of the two industries, to let their voices be heard as one on this coal question. Our information at present only extends to the short report of the Manchester meeting published in other columns. But such a conference can only be arranged through the central organizations of the two industries. Whatever is done, however, must be done quickly; and if the Government can be impressed with the seriousness of the question, and can be moved to effective action, the country, through the easing of coming coal contract prices and the supplementing of supplies, will soon feel—especially next winter—the benefit of the action. We shall welcome intelligence as to just what is being done in the matter; but let it be treated as one of emergency, and not as one that can go through the leisurely routine of preparation sometimes followed through a scrupulous regard for the canons of procedure in the work of technical organizations.

Essentials of Modern Gas Supply.

In fulfilment of a long-standing engagement, Mr. W. Cranfield last Saturday delivered the annual lecture to the Scottish Junior Gas Association (Western District). To the lecture the title was given—"The Essentials of Modern "Gas Composition." Such essentials ought to be known to every gas man, in responsible technical place, and, indeed, they should be of the rudimentary part in the scheme of the education of every gas manager. This is not by any means the first time that they have been discussed, separately and in mass, before technical gas organizations. But as it must be admitted that there is in some towns a considerable falling away from these essentials, it is an excellent thing to have them from time to time brought before members of the profession—not only of temporary second rank, but of the already existent first rank; for this may have the effect of bracing-up to better deeds the inveterates in negligence and backsliding in this particular direction. It is because of this, and of the manner of presentment, rather than for the matter it contains, that Mr. Cranfield's lecture is of value.

The idea is far too prevalent, and not only (as the lecturer courteously puts it) "among the general public," that, if gas of a certain illuminating power or calorific value were supplied by all gas undertakings, this would mean a universal standardization or uniformity of supply. Some consulting engineers and some official gas managers have been heard voicing the belief that with one calorific power throughout the length and breadth of the British Isles, the day of the standardization of all domestic gas appliances would be within reach. Of course, it would not be. Variations in gas constitution and in other essential matters have many loopholes—from coal throughout plant, processes, and conditions, even in the same plant; and until all the differences can be eliminated, and working conditions can be given a cast-iron invariability (which will never be), the ideal of a universal standard gas will not be realized. But despite what Mr. Cranfield says in this regard, there have been some wonderfully concordant runs of gas production shown by the aid of automatic recording instruments; the diagrammatic curves indicating a fair uniformity in respect of some of the essentials to which the lecturer alluded.

But these essentials, while important, are but of a number. Not only must there be freedom from ammonia and sulphuretted hydrogen, but sulphur compounds should be kept down, and composition, calorific power, and pressure should be maintained proximate to a reasonable and practicable level. All gas men know these things; but all gas men do not give them—save those which carry penalty for default—the consideration that they ought to have. But for the information of those of our legislators at Westminster who take an intimate interest in the affairs of the gas industry, and others whose professional occupation includes that of advisers of local authorities who are afflicted with an insatiable desire to bridle gas companies anew on every conceivable occasion, and by every conceivable means, let it be said that the negligent gas men in these matters are not in the majority. We do not want any false impressions to get abroad; for the industry has here and there already suffered sufficiently from dissolute management and from (to greater extent) finical gas legislation. There has been abrogation of the clauses relating to sulphur compounds; but in certain of the very places where there has been this cancellation, there has been new procedure to realize even a greater purity. This illustrates the fact that compulsion (beyond the compulsion necessitated by the fight for a prosperous existence) is not in all cases requisite to enforce compliance with essentials. The statement of these essentials is not intended as a universal arraignment of the gas industry on the count of their neglect. If one is a consumer in a district where the gas is sent out loaded with sulphur, then there will undoubtedly be trouble and discomfort, and very properly complaint and loss of business. Mr. Cranfield seems to have had some bad experience in this regard, as instanced by his reference to what happened in connection with the use of gas on top of a cooker in a small scullery. Use of gas in the areas of five different companies has not brought the writer a like experience. Naturally, if one goes and puts a flueless heater into a bedroom or passage where there is small ventilation (which is a witless thing to do) there is likely to be inconvenience; but in a large well-ventilated office, it should be possible to employ steam gas-heated radiators without causing the atmosphere to become highly sulphurous. If we cannot do this, then, as Mr. Cranfield says, it is not the radiators but the abnormal richness of the gas in sulphur that is at fault, and so is the gas management. Then, again, a gas unduly laden with sulphur will have a corrosive action on burners, fittings, water-heaters, &c. "Electricity," remarks the lecturer, "has such an advantage on this score that, in sheer self-"defence, we ought not too easily to rest satisfied with the "existing situation, or to readily admit its inevitableness.' We do not like the words "existing situation" in this connection. They carry the idea of universality, and such an idea, as much as any expression which gives it birth, is unjustified.

Touching the question of calorific power, the lecturer says it is the inevitable standard by which to judge a gas, in view of all its uses being dependent upon calorific power. "The "standard is neither a fictitious nor a conventional one," he remarks, "but a real criterion of value." This statement requires qualification; for, as those know who have studied the matter in relation to gas composition and flame temperature, and as the lecturer himself shows later on, calorific value may not under certain circumstances be a real criterion of "value." In leading up to the subject of flame temperature, Mr. Cranfield expresses his conviction (a point that has frequently been made in these columns, and as recently as last week in dealing with bye-product coke-ovens for town gas supply) that a high calorific value gas is not required—in fact, he considers that 500 to 550 B.Th.U. is too high, and unnecessarily so. The efficiencies obtained in some domestic applications may be absolutely lower with a high calorific power gas than with a lower one, in view of the fact that a high calorific power gas needs more air for its combustion, to the detriment of flame temperature. Furthermore, a gas complying with a standard of (say) 500 B.Th.U. may not be so good to the consumer as another gas of precisely the same calorific power, owing to the presence in the former of an undue proportion of inert constituents which form vehicles for the transmission of heat from the flame with the products of combustion. The absurdity of some statements that have been made in Parliamentary Committee Rooms, in arguing, in the names of local authorities, for some higher standard of calorific power would have been obviated, if those who were responsible had known anything of the subject of flame temperature, and the conditions necessary

for attaining the highest practical degree. But there are some people whose only basis of judgment in such matters as this is a numerical one—the questions of suitability and efficiency under the conditions of use, or, in other words, the best possible value for the consumer, are altogether beyond them; and it is a thousand pities when nescience and dogmatism obtain the verdict in such matters as this.

In connection with this subject of calorific power testing, we see that Mr. Cranfield is in favour of occasional check testing on the district. So long as the district testing is confined merely to check work, there is not much objection to it; but the statement ought not to be possible, as the lecturer says it is, that on a district he has obtained results 20 per cent. below what are claimed to be maintained at the works. This is not the case in well-ordered works. It means—and there are people who will gladly lay hold of what the lecturer might have stated was no doubt an exceptional case—that if the gas was claimed to be of 500 B.Th.U. at the works, it was only 400 B.Th.U. on the district. The feasible explanation is that the gas was not 500 B.Th.U. at the works; and, if the lecturer had made a check test there, he would in all probability have found that this was so. An interesting record of tests as to loss of calorific power with gas under pressure, varying up to 100 inches, and after travelling some eight miles, was published in our columns last week (p. 74). The average loss in calorific power in the conditions named only amounted to 3·2 B.Th.U., or 0·52 per cent. The whole of the accumulated results of investigation into this matter point to the smallness of the loss of calorific power in the distribution system; so that if proper tests are carried out at the works, the occasional check tests advocated by Mr. Cranfield become a refinement. Earlier, the lecturer himself used a passage which has a bearing upon the point: "It is well to face facts "frankly, and not to carry out calculations to a degree of "minuteness inconsistent with the limits either of the appa- "ratus or of the investigator." We do not want occasional or exceptional experiences to be the causes of placing additional burdens upon the industry. This is said with "facts" before us which have had their origin in an external and fatuous desire to impose unnecessarily harsh legislation on gas undertakings, though candidly we should be the first to say, "It serves them right," if greater controlling and restricting legislation were placed upon those who are not properly fulfilling their trust. But the infliction of penal district testing in connection with calorific power has been a matter that local authorities have several times attempted to thrust upon gas companies. The objection has not been so much the fear of penalty, but the inconvenience of having, at all sorts of times, to arrange for officials to be present to check the conditions and results of the tests.

However, without dipping any further into the lecture, the essentials for a gas supply, as presented by Mr. Cranfield, are purity, constant calorific power (lower than has been commonly adopted), adequate and constant pressure, only a small proportion of incombustible constituents, high flame temperature secured by a low air-gas ratio, low nitrogen content, diluting gas if necessary with blue water gas, rather than degrading it by a large proportion of inert constituents, no excess of hydrocarbons so as to obtain ample aëration of flame, and constancy of composition. Gas in normal times is making large progress; but compliance with these "essentials" will help to extend appreciation and the limits of service; and it will further strengthen the foundations of the industry.

Development of Industry through Science.

The philosopher who observes the current changing phases of thought and action in regard to matters that were strangely neglected in many places and under divers circumstances prior to the war, will be struck by the phenomenon of how much will be due to the war if it be the means of transmuting the neglect into action of a large and beneficial order. We believe the war will have this effect; and therefore that this will be one of its advantageous issues. The national dye scheme came to the surface among other of the country's pressing affairs. Its appearance at once set the inquisitive to work to ascertain why it was that Germany had so successfully, and so extensively, built up its great chemical industries for the production of dyes, synthetics, and a multitude of refined products, and why this country was so lamely dependent upon Germany for the bulk of its requirements in these directions. The explanation was not far to seek. It does not by any means rest alone in financial aid, nor in organization, but also in the thorough and systematic manner in which in that country there has been the very closest co-operation between science and industry. That there has not been the same close co-operation universally in our industries—that there has not been the same unceasing research which has produced for Germany such a strength of position—is the seat of our weakness.

But where does the fault for this lie? We have been reading a mass of oral and written statement on the subject by men of position and influence in the educational, scientific, and industrial worlds. Sir Philip Magnus says the educational institutions of Germany are not superior to our own; nor is the standard of technical education higher. Sir William Ramsay, Sir Henry E. Roscoe, Professor W. H. Perkin, D.Sc., F.R.S., Sir Alfred Mond, Sir Philip Magnus, and others all bear witness to the fact that there is no dearth of trained Britishers—men fully equipped for immediately entering upon research work in connection with industry. And the "Lancet" bears witness that the principles and methods which have led to the success of the dye and chemical industries in Germany are perfectly well known to British chemists. There we have the training institutions, the men, and a knowledge of the working principles and methods of Germany. Then it comes to this, that the chief secret of our backwardness in the industries in which Germany has made most progress is that the living material which we have at command has not been brought to bear sufficiently upon the success of these industries. We have the deplorable fact stated on the authority of Professor Perkin that "there is not a single dye-works in this country "that has a really brilliant scientific head." This is condemnation indeed; and Professor Perkin ought to know the truth of the matter, and no one better. If there is neglect in such an industry, what of the others? We get from most of the men whose names have been mentioned an attack on the sparseness of the research work in British industries; and in other quarters there is a protest against the niggardly character of the emoluments which the directors of industry and commerce think adequate for the payment of those who apply science to industry, and so help in the progress of the latter.

It is clear from these briefly presented facts, given on the strength of authorities, that the whole fault—speaking generally and not comprehensively—for the extensive neglect of science in British industry is due to the manufacturers and those in control of manufacturing operations. This, however, can go on no longer. There must be continuous scientific research; and there must also be scientific control. Without these, without greater collaboration between industry and science, we might just as well give up all hope of occupying some of the ground of which Germany by years of assiduous and well-organized work took possession, and of making *pari passu* progress with that country in industry and commerce. Professor Perkin says in regard to the dye industry that there is no need for failure if we develop on research lines. This applies to other industries. If one result of the fearfully destructive war is to strengthen the appreciation of British manufacturers of the truth of these things, and to induce them to put into practice what is needful, this will be a constructive issue for which the country will hereafter have cause to be very thankful.

Value of Coke-Breeze as Boiler-Fuel.

We are pleased that the writer of the article on this subject which appeared, together with some editorial comments, in our issue for March 30, returned to the question last week (p. 71). The further contribution would then have been referred to had time and space permitted after the receipt of the contribution. His admission that the prices of coke-breeze on which his protest was originally made were rather unstable as applied to recent and current dealings clears away one point of the previous editorial comment; and with much of the rest of the second article, there can be complete agreement on our part. The object of our correspondent is the excellent one of doing something towards getting nearer to the realization of full value for whatever breeze there is available for the market. There is no question that, from the fuel value point of view, higher prices than are customary should be obtained. Relatively, however, there is, after satisfying a gas-works' own requirements, a very small quantity of coke-breeze for outside disposal; and, therefore, our contributor says, had he been

dealing with coke, and not coke-breeze, his attitude would have been somewhat different. Then he would have paid more heed to the point as to there having been a pre-war market price for coke (gas managers have a dismal recollection of it), and that there will be a coke market post-existent to the war. What is this after-war coke market going to be like? No one can yet tell. But this may be said, that it will partly fashion itself according to the work that is now done. Pre-war prices induce those possessing foresight, and with coke for sale, to do all that is reasonably possible in these days of exceptional opportunity "to "obtain extended trials of it, and to advertise its value in "the hope of creating a permanent demand for it in normal "times." But our correspondent says we are dealing with coke-breeze, and not coke. Perfectly true. But the coke-breeze may be used as a paving to a beneficial end, and that end a larger knowledge in fresh places of the value and use of the more plentiful coke for steam-raising. That is why, so long as a reasonable price can be obtained, a demand in these days for the uttermost penny of the full fuel value for coke-breeze does not appeal to us.

In ascertaining the relative effect of an increase in the price of coal upon the cost of gas and electricity, our correspondent thinks it wrong to take the total generating costs of an electricity-station and the net manufacturing costs of a gas-works. Very well. His view is that, in making comparison, fuel only ought to be taken in the case of the electricity-station, and coal, less coke (why not total residuals?), in the case of a gas-works. We are not convinced that in this connection he has adopted fairly representative figures. He assumes for the purpose of his argument an electricity company selling electricity at an average of 1½d. per unit. He should not assume anything of the kind for London, because in the case of the London Electricity Supply Companies (not Borough Councils), taking the fairly normal year of 1913, they were not supplying at anything like such a low average figure—that is, eliminating three exceptionally circumstanced companies. Omitting the Central, London, and South London Companies, the average price received by the other eleven companies in 1913 was 2·91d. per unit. Our correspondent will see that the low average price that he took would, in working out the percentage rise produced by the cost of coal, be in favour of his argument and against ours. The average price of gas in London in 1913 was 2s. 3·7d., not 2s. 6d. This makes very little difference; but we are dealing with average prices, and uniformity is desirable. The average cost of coal delivered to the London Gas-Works in 1913 was 15s. 9d. per ton; and if we follow our correspondent's plan, and take the coke receipts as half (omitting the other residuals), the cost of coal is 7s. 10½d., or (say) 7·87d. per 1000 cubic feet of gas sold. The average fuel cost of the eleven electricity companies in 1913 was 0·44d. per unit sold (with coal at 15s. 9d. delivered this would be equal to 429 units per ton). Now taking our correspondent's assumpton that the price of coal rises for both services to 22s. In the case of the gas companies, again taking his rough deduction of half the cost of coal being realized by coke, we have 11s. for coal per ton, or 11d. per 1000 cubic feet of gas sold. In the case of electricity (adopting the 429 units per ton of coal), the cost of fuel per unit generated would go up to 0·61d. So we have coal rising per 1000 cubic feet of gas sold by 3·13d.; and fuel costs per unit of electricity by 0·17d. That is to say, 0·17d. to add to the average price of 2·91d., instead of our correspondent's 0·2d. on 1½d.; and 3·13d. to add to the average price of gas (2s. 3·7d.) per 1000 cubic feet. Instead of our contributor's equality in the percentage rise (13·3 per cent.) on electricity and gas, it is seen that the rise is 5·84 per cent. in the case of electricity, and 11·3 per cent. in the case of gas. The assumed figures of our correspondent—more particularly the average one of 1½d. per unit sold—are not very reliable for arriving at the actual relative effect of an equal rise in the price of coal upon fuel costs for electricity generation and the cost of raw material for gas-making purposes. At any rate the figures we have quoted, from analyses of gas and electricity accounts, with the foregoing percentages, are in favour of our contention that the increase in the cost of coal does not bear so hardly on electric stations as on gas-works.

Maintaining the Duty of Street Lamps.

Whether or not the lighting of streets or other places is contracted for on a candle-power or illumination basis, it is, in these competitive times, to the interest of the suppliers of gas to see that their lamps are rendering proper duty. Gas has an advantage over electricity in this matter—the light with gas-burners can be easily maintained. A little regulation, a new mantle, or the removal of dust from the burner, and a lamp can be immediately restored to its original capacity for service. With flame arc lamps, the fumes given off, and the deposit on the bottom of the globes, are detrimental to the constant maintenance of original candle power. The bulbs of metallic filament lamps also become blackened; and there is a depreciation of the light, which cannot be remedied as in the case of gas-burners. In consequence, the entire replacement of the lamp is necessitated. Where street-lamps are contracted for on a candle-power or an illumination basis, a photometer for the candle power or a "Lumeter" or other similar instrument for making foot-candle measurements is required. The street tests involve difficulty and a good deal of worry; and the number of lamps that can be tested in one outing is comparatively small. In the case of lamps for which contracts are made with nothing but a nominal candle-power distinction given to them, and no condition attaching as to the testing and maintenance of the candle power, nothing is done beyond eye inspection to see that the lamps are in decent light-giving order. Something is wanted by which a rapid survey can be made to definitely ascertain whether lamps are rendering their proper duty. In our "Register of Patents" last week, there was a description of an instrument invented by Mr. J. S. G. Thomas, of the South Metropolitan Gas Company, which may greatly help in this work. It is called a discriminating photometer, and, by setting it, one can, on applying it to the eye, ascertain whether a lamp is giving light above or below its proper duty. This should be a very handy contrivance, if reliable; but on this point of reliability we have as yet had no experience or evidence.

A Double Flood of Adversity.

Gas share and stock holders in this country are taking very philosophically the set-back in their proprietary conditions which the war has brought upon them. Of course, they are aware that what has happened could not be avoided, and that, after all, it is only a temporary matter, and that the old position will gradually be retrieved. But they are not in such bad case as are, for the time being, the shareholders of the Primitiva Gas Company. This Company has had its prosperous course interrupted not only by the war, but by an unparalleled trade crisis in Argentina, on top of which came the war, bringing in its train financial chaos, heavy freights, and higher coal prices. In the past year, through the double heavy trouble, there was a decrease of no less than 34 per cent. in the quantity of gas sold for private lighting. British share and stock holders who mourn a loss of 5 per cent. or under should think of this—a drop of upwards of one-third in the lighting business! On the other hand, there was a small increase in consumption for heating, cooking, and power. The total reduction in the amount of the accounts rendered to customers was no less than 13 per cent. on the total volume of business of 1913, or £145,000; and the total decrease in net revenue for the year was £84,665. In addition to the high price of coal, freights to Buenos Ayres (which are now slightly easier) have been 32s. 6d. per ton, against 14s. at the same time last year. Under their concession the Company have no power to raise the price of gas. That is a condition which the gas companies at home have not to face, as even where there is a maximum price fixed, there is always a good margin allowed. For the Primitiva ordinary shareholders, there is no final dividend for last year. Home gas shareholders have something for which to be thankful even in these times. But good business is again being done in the produce of the Argentina, and high prices are being obtained. In consequence, normal conditions in relation to gas consumption are gradually returning. Coal and freights are the real black spots of the present. Altogether, there is composure as to the old prosperous conditions being restored, and that before long.

A Barren Report on Spent Liquor Disposal.

The final report of the Royal Commission appointed to inquire into the methods of treating and disposing of sewage, in part deals (as will be seen elsewhere) with the question of the discharge into sewers and streams of spent liquor from gas and other coal-carbonizing works. It cannot be said that the Commissioners have added to prior knowledge on the subject; but it can be said that there is absolutely nothing to be gleaned from

the report which will be helpful to sulphate of ammonia makers in regard to a question which does not add to the amenities of their lives. It did not require the report to tell them that there are limits to the quantities of spent liquor that may safely be discharged into sewers without affecting the efficiency of sewage works by hindering the development of the bacteria required for purification. It did not need the report to inform them that untreated spent liquor ought never to be discharged into streams, nor that gasholder water when tanks are emptied must not under any circumstances be sent into watercourses. It has for long been known, too, that even as low as 3 per cent. by volume of untreated spent liquor is seriously detrimental to life in the bacteria beds of sewage works. The one definite piece of guidance is that the Commissioners are of opinion that an amount of spent liquor equal to 2 per cent. by volume of the sewage may, without serious effect to bacteriological purification, be allowed to flow into the sewers, providing the flow is uniform, and not in flushes. When the spent liquor is subjected to partial purification, a larger volume may be mixed with the sewage. But here the Commissioners again fail us. They do not know of a fairly successful purification system, other than the biological one of Dr. Gilbert J. Fowler ["JOURNAL," May 9, 1911]. In this case, however, the Commissioners hint at expense; and the "fairly successful" does not breathe complete satisfaction. There is no mention of the purification system of Mr. John Radcliffe, about which excellent reports were heard a few years ago, and by which the injurious substances of the spent liquor—particularly the phenolic bodies and the compounds of cyanogen—were so far continuously and automatically removed that it was said quite 25 per cent. of the purified spent liquor could be added to the volume of sewage without injuring the efficiency of the bacteria beds. We should like to hear from both Dr. Fowler and Mr. Radcliffe as to their further experiences, in the light of the Commissioners' report. The Commissioners refer, but not with any particular commendation, to the evaporative method of treatment. This is all very well where there is isolation; but in the case of gas-works, situated as they are near (and in) residential localities, the evaporative method would be an unpardonable source of local nuisance. The inability of the Commissioners to offer something useful in the way of recommendation suggests that the field for research here is still quite an open one.

Coal Exports and Oil Imports.

The Board of Trade returns relating to our foreign trade in March show that 2,027,000 tons of coal less were exported than during March, 1914. In February the quantity was 2,189,714 tons, and in January 2,319,373 tons, less than in the corresponding months. In the preceding five months of the war—August to December—the average reduction per month, compared with the same period of 1913, was 2,721,750 tons. If these figures are compared, it will be noticed that the reduction per month, in contrast with the same months of 1913 or 1914, as the case may be, is steadily on the decline. This being so, it would be interesting to know the ultimate destination of the extra coal which is now going out of the country compared with the five war months of 1914. The total reduction of coal exports during the eight months of the war is 20,144,841 tons, of which 13,608,754 tons apply to the five months ending December, and 6,536,087 tons to the expired three months of this year. Of the coal exported to neutral countries, we could have done with large part, if not the whole, at home. The Government may look into this deprivation of necessary supply for the home land for the benefit of neutral countries now that the Board of Trade Coal Committee have put forward the restriction of coal exports during the war as a protective measure for our own people and industries. Oil imports show a value increase of £1,297,623; and there is the satisfactory feature that while petroleum rose 42 per cent. in quantity, the value was only up 28 per cent.

Bonus and Permanence.

Those who promote discord in the country at the present time are its worst enemies. If rumour is truthful, the leaders of the Gas Workers' Union may be so classed. Directors and Committees of many gas undertakings have voluntarily granted a war bonus to their employees in consideration of the increased cost of living; and it is now reported that the Union leaders are, in certain places up North, intending to make a demand for the bonus to be converted into a permanent increase. Is it a fair demand to make when the duty of everyone is to do all that within him lies to help the country through these critical times? There are not two answers to the question. If the report is correct, then all we can say is that it is a mean proposal, and unworthy any Britisher. We hope the gas-workers themselves will see this, and that there will be, on their part, a large repudiation of any such action, if taken, by the Union leaders. This is not the time to try to stir-up strife. There is already a shortage of men in gas-works, through the large gaps made in the ranks of sub-officers and men by their answer to the call of King and country. The Union leaders know this; and the fact of this knowledge would intensify the meanness of any movement such as it is suggested is to take place. A nice spectacle it would be—while gas-workers are in the trenches at the front, while others are preparing to go, while their dependants are being cared for at home by gas companies and committees, while the men who are at home are receiving an addition to their ordinary salaries to meet their extra expenses during the war—if any demand to make the bonus a permanent increase of wages led to difficulty and interruption of public services. It is hoped that men in the gas-works throughout the country will show that they, at any rate, have something more manly in them than have those from whom any suggestion such as that referred to has emanated. We trust the whole thing is a mistake; and that rumour is false. If it is, we shall gladly be the first to acknowledge the wrong done the leaders of the Union by entertaining for a moment the thought that they could be guilty of such a contemptible action.

SOUTH METROPOLITAN CHIEF ENGINEERSHIP.

Resignation of Mr. W. Doig Gibb.

WITH considerable regret, we learn that Mr. W. Doig Gibb has felt that duty to himself and to the South Metropolitan Gas Company compels resignation of the Chief Engineership of the Company—an office which, not only in view of the position of the concern, but on account of the distinguished associations of the office itself, confers honour upon any occupant.

It will be remembered that, at the meeting of the Southern District Association of Gas Engineers and Managers on the 11th ult., it was mentioned that Mr. Doig Gibb, who is Vice-President of the Association, had written to say that through illness he was unable to be present; and the hope was expressed, in the name of the members, that he would be speedily restored to health. The hope has been partly fulfilled; but the illness has brought about the determination to resign the responsibilities of the Chief Engineership of the Company. Mr. Gibb is a Northerner; and, almost from the beginning of his residence down South, he has felt the enervating influence of the change. Upon a weakened condition of his health came the worries of the war—more particularly those associated with coal and freights—and then the breakdown. Mr. Doig Gibb (who is again out and about, and, we are pleased to find, as cheerful as ever in disposition) has been medically advised to take three or four months' continuous rest. This has resulted in his determination to, for that period at any rate, relinquish all professional ties and duties; and on Wednesday last he formally handed in his resignation to the Board. The severance will be a great regret; the cause of it a still greater one. For between the Chief Engineer, the Chairman and Directors, all ranks of officials, and the men, the utmost friendship and cordiality have existed since, five-and-a-half years ago, he came among them as the Company's chief technical officer. It was remarked in the "JOURNAL" at the time Mr. Gibb came South—in 1909—that the loss was that of the Newcastle and Gateshead Gas Company, and the gain that of the South Metropolitan Company. Although his services in London have been comparatively short, the years have been extremely busy ones with the Company; and during the coal strike of 1912, last year, and now, naturally the time has been a very anxious one, in view of the magnitude of the Company's operations.

The Board have marked Mr. Doig Gibb's services in a manner which during his lifetime will be a constant reminder of their appreciation. The sincere wish of all his colleagues will we are sure be that, as soon as rest has effected the promised rehabilitation of health, Mr. Doig Gibb's abilities and energies will again be at the disposal of the industry, assisting in directing its technical and commercial fortunes.

The late Mr. Arthur Keen, the Chairman of Messrs. Guest, Keen, and Nettlefolds, Limited, of Birmingham, whose death was recorded in the "JOURNAL" for the 16th of February, left estate which has been provisionally sworn for probate as of the value of £1,000,000 in net personalty.

PERSONAL.

Mr. H. J. BENNETT has recently been appointed Manager of the Roscrea (co. Tipperary) Gas-Works.

At a meeting of the Directors of the Budleigh Salterton Gas Company Mr. FRED G. HILL was appointed Secretary, in succession to the late Mr. A. H. Passmore.

Mr. FRANK BELTON, son of Mr. J. C. Belton, the Engineer of the Chester United Gas Company, has been appointed Assistant-Engineer to Mr. J. E. Blundell, the Gas Engineer to the Macclesfield Corporation.

In the list of associate members reported as elected at last Tuesday's meeting of the Institution of Civil Engineers were: Mr. CHARLES M. D. BELTON, the Assistant Engineer of the Shrewsbury Gas Company, and Mr. FREDERICK YOUNG, the Manager of the Brampton (Cumberland) Gas Company.

The Gas Committee of the Nelson Corporation have placed on record their appreciation of the conspicuous ability with which Mr. A. MORTON FYFFE has served the Corporation as Gas Engineer during the past five years, and their wish for his success in the similar position to which he has been appointed under the Blackburn Corporation.

The Stockton Town Council have chosen, out of 126 applicants, Mr. T. PEIRSON FRANK, the Borough Surveyor and Water Engineer at Newark, to fill the position of Borough Engineer, in succession to the late Mr. M. H. Sykes. Mr. Frank began his career in 1899 under Mr. K. F. Campbell, the Borough Engineer of Huddersfield, to whom he was articled. Leaving Huddersfield in 1903, he went to Dewsbury as Deputy Borough Surveyor and Water Engineer, and vacated this office in 1908 to take up the duties of City Surveyor of Ripon. In 1912 he obtained the appointment at Newark. He is a Fellow of the Surveyors' Institution, and an associate member of the Institution of Civil Engineers, and of the Institution of Water Engineers.

Mr. H. R. WIMHURST, who has been appointed Engineer and Manager of the Bury St. Edmunds Gas Company (and will take up his duties on July 1 next), is the son of Mr. Harry Wimhurst, and was educated at the Alvey and Collegiate Schools, Sleaford. He then spent three years under his father at the Sleaford Gas-Works, and a further three years with Mr. Robert Porter, the Engineer and Manager of the Elland Gas Company, at the end of which time he secured the position of Engineer, Manager, and Secretary of the Irthlingborough Gas Company. Upon the resignation of Mr. J. G. Hawkins as Engineer and Manager of the gas undertaking of the Spalding District Council, in 1903, Mr. Wimhurst was successful in obtaining the appointment, from among a large number of applicants. While at Irthlingborough and Spalding he did much to remodel the works and bring them up to date. He is a member of the Institution of Gas Engineers, of the Committee of the Eastern Counties Gas Managers' Association, and of the Spalding Lodge of Freemasons.

OBITUARY.

General sympathy has been extended to Mr. ANDREW GIBB, for many years Manager of the Newry Gas-Works, on the death of his wife, who had reached an advanced age.

Mr. ALFRED FYNN PHILLIPS, who was Accountant to the Imperial Continental Gas Association, passed away, we regret to learn, after a lengthy illness, last Tuesday. He was appointed Accountant in 1897, and held the post until his retirement, on completing fifty years' service with the Association, in 1909. His son, Mr. W. A. Phillips, is a member of the London staff of the Association.

The death took place recently at Berlin, at the age of sixty-two of Professor OTTO NIKOLAUS WITT, Ph.D., F.I.C., of the Berlin Technical Academy. Professor Witt was one of the best-known men in German chemical technological circles. He received his early scientific training in the Zurich Polytechnic School, and afterwards graduated as Ph.D. in the University. He came to England to take up a position in an aniline dye works, and in 1876, while in London, he was elected a Fellow of the Chemical Society. He was also an honorary member of the Royal Institution. Leaving London some years later, he was engaged in the works of Messrs. Leopold Cassella and Co., aniline dye manufacturers, of Frankfort. In 1896 he was appointed Professor at Charlottenburg.

The death occurred last Tuesday, in his ninety-fourth year, of Mr. JOSEPH SMITH, the Chairman of the Romford Gas Company. He had lived at Romford since he was ten years of age, and until recent years was closely associated with the public life of the town. He became a Director of the Gas Company in 1861, and had been Chairman since 1866. On attaining his jubilee as a Director on May 1, 1911, he was presented by the Company with a set of decorative table silver. He was continuously a member of the Local Board of Health and the Urban District Council for twenty-nine years, and on his retirement he was presented by the Council and officials with an illuminated album of photographs. He was Chairman of the Council from 1905 to 1907, and for a number of years was on the Commission of Peace for Essex.

"LIGHTS OUT" AT NEWCASTLE-ON-TYNE AND GATESHEAD.

PROMPT compliance by the Newcastle-upon-Tyne and Gateshead Gas Company with the notice from the authorities to extinguish the public lamps on the occasion of last Wednesday night's Zeppelin raid on the Northumberland coast, was greatly facilitated in the Newcastle area by the large number of automatic controllers in use; while in Gateshead arrangements made in advance worked with the utmost smoothness and rapidity.

In the city of Newcastle, there are over 6700 Alder and Mackay and more than 200 of the Distance Lighting Company's apparatus in use; these figures comprising over two-thirds of the total number of public lamps in the city. The only other place where distance apparatus is fixed in the Company's district is Gosforth, the nearest lamp in which is about 2½ miles from the governor-house operating the pressure-wave, and the furthest some 4 miles away. Here the whole of the gas-lamps are fitted with apparatus—584 Distance Lighting Company and 41 Alder and Mackay—all of which are operated with the same wave actuating those in the city already referred to. Upon the Company receiving notice from the authorities to extinguish the public lamps, the pressure-wave was successfully put in operation within five minutes; and the remainder of the lamps in the city not fitted with apparatus were immediately commenced to be extinguished by hand.

With regard to Gateshead, the Company have over 2700 public lamps, only 250 of which are fitted with controllers (and these of clockwork type, experimentally); and in case of an air-raid the whole, of course, had to be treated as hand-lit lamps. To ensure them being extinguished in the shortest possible time, the Company weeks ago "billeted" the lamplighters immediately opposite the borough police station, providing them with beds and other necessary comforts. As a result, within three-quarters-of-an-hour of receiving orders to extinguish the lamps, the town of Gateshead was practically in darkness, notwithstanding its large area—a fact on which the Distributing Engineer (Mr. John Lewis) is to be congratulated.

ELECTRICITY SUPPLY MEMORANDA.

"Rapid Progress." (?)

THOSE of the members of the Junior Institution of Engineers who have followed the history of the electric heating and cooking business will have recognized the oft-repeated electrical tale in the paper read at the meeting yesterday week, by Mr. Stanley M. Hills, Assoc.M.Inst.E.E. We read papers of the kind, in search of something new; but for the most part now, it is only the manner of telling the tale that deserves the description. There is one thing that probably the non-electrical section of Mr. Hills' audience will have been impressed by, and that is the slowness with which electric heating and cooking have progressed. It was in 1890 that the first electric heaters were exhibited at the Crystal Palace; and electric heaters have not yet been able to supplant solid fuel in the ordinary grate as the means of regular heating to the same extent that gas-fires have done. Electric heaters have obtained a comparatively small vogue for occasional use—nothing more. What is the reason for the more rapid advance of the gas-fire? Common-sense people will naturally reply that there can only be two reasons—the greater efficiency and the lower cost. But electricians are persistent with their sorry tales that the useful heating efficiency is less with the gas-fire than with the electric heater, and that the cost is about equal. The extent of public preference for the gas-fire is the reply. Then in 1908 the first "Tricity" cooker was placed on the market. That was seven years ago. Mr. Hills says from that time onward "rapid progress" has been made. We should like to see those words "rapid progress" translated into figures in relation to the number of householders in the towns of the country who have adopted electric cooking. The majority of the members of the Junior Institution, casting round among their circles of friends, would have considerable difficulty in tracing the tracks of this "rapid progress" among them. There have been restaurants that have adopted electric operation; but these are mostly electrical advertisements, and are under constant electrical inspection so as to keep things in order as closely as possible. Romano's electric-grill has been widely advertised as showing independent favour; the electric-grill was the first thing to be closed-down at the well-known restaurant on the outbreak of war. Romano's have not gone over to general electric operation in their kitchens as a result of their experience with the grill. A few business houses and educational places have adopted electric operation through interest or as the result of the importunities of electrical friends. But, again, these are under the frequent scrutiny of the district electrical engineers. The installation of electric cooking appliances in the new part of Selfridges was made much of the other day; but Selfridges are not prepared to evict the existing cooking appliances in their kitchens in the older established parts of their premises. We may be sure that Mr. A. H. Seabrook, who saved up this *bonne bouche* for his remarks on Mr. W. R. Cooper's paper at the Institution of

Electrical Engineers, will arrange (his experience advises him as to what to do) for the careful nursing of this Selfridge installation, so that it may find favour in the eyes of the firm. Those members of the Junior Institution who want to learn the real truth of the matter about electric cooking, and as to the views of other electrical engineers on the subject, will get some indications as to expense of installation, maintenance, cost of over-all operation, and unreliability, by reading the recent discussion on the paper by Mr. Cooper. Dissatisfaction was then expressed; and among much else, it was seen that electrical engineers are somewhat partial to gas coke for heating water, owing to the expensiveness and waste of time of doing the work by electric means. Gas undertakings have had the agreeable duty of carrying-out work in houses where there has been a spell of electric operation—among other things they have re-established gas-cookers. But they have not made any song over the matter.

Electric Heating—Troubles and Precautions.

Mr. Hills had something to say in his paper in praise of electric heating; but when one strips certain facts of the praise and descriptive statements, a fair amount of naked truth is found. For instance, with electric-radiators, it is seen that light construction has been the cause of much dissatisfaction. The author advocated very close inspection by electrical engineers of the organism of radiators before being fixed, in order to do something towards preventing users from having unpleasant experiences. The makers of such domestic appliances seem to be a careless lot. The author himself has found no less than five "dead-shorts" in one day when testing radiators before delivery to the purchasers. Electrical convectors were also referred to. These are usually perforated to "assist ventilation;" but with what result? Dust collects on the resistances, which causes a disagreeable odour to be emitted. Radio-convectors were also described. Then succeeded eight points which the electrical engineer is advised to keep his eye on before radiators are fixed on consumers' premises. It should be ascertained that the radiator frame is mechanically sound and rigid; that the internal wiring is of the best material, and the conductors capable of carrying at least twice the current the radiator normally consumes; that an efficient reflector is placed at the back of the source of heat; that two heats are provided—one for initial use in first heating the room, and the second for maintaining the temperature of the room; that radiators used on circuits of over 200 volts have an efficient arrangement for earthing the frame; that means are provided for the easy replacing of the heating units by the consumer himself; that the flexible connections are of the best quality, and capable of carrying twice the normal current of the radiator; that the switches are capable of carrying a 50 per cent. overload, and the current-breaking capacity is equal to twice the normal load; and that the reflectors are readily accessible for cleaning. Compare all this with the simplicity of the gas-fire! There is condemnation of long lengths of flexible wire; and the advice is given that in houses where several radiators are installed, arrangements should be made for dividing the installation into small circuits with separate fuses—Mr. Hills' view being that it is exasperating for a consumer to sit and freeze, because a fuse has gone. In cold weather, with ordinary electric heaters, users—unfortunately for the electricity suppliers and fortunately for gas suppliers—sit and freeze without fuses going, unless the heaters are capable of absorbing an extraordinary amount of current. We compliment the author upon being opposed to those electricians who brick-up fireplaces, in order to conserve the heat of electric radiators. There must be adequate ventilation, and the air of rooms must be changed three or four times an hour; otherwise the occupants have another cause of complaint.

Heating Costs.

Mr. Hills has fallen into an error. He has taken Mr. R. Weaving as an authority on comparative heating costs. This gentleman lately read a paper before the Birmingham Electric Club; and his comparisons were dealt with in the "JOURNAL" for March 16 (p. 673), as well as in a previous issue. There has been no reply from Mr. Weaving to what was said on the last occasion. On point of cost, said Mr. Hills, coal is the cheapest fuel; while the cost of gas and electricity is "about equal" with gas at 2s. 3d. per 1000 cubic feet and electricity at ½d. per unit. Of course, electricity is not being sold at ½d. in any but two or three places. With the percentage on rateable value, the average cost per unit comes to much more. But supposing 2 units are purchasable for 1d. for heating, they would be equal (assuming 100 per cent. efficiency) to 6840 B.Th.U. At 2s. 3d. per 1000 cubic feet, 37 cubic feet of gas can be bought for 1d.; and, reckoning only 500 B.Th.U. per cubic foot (and not the statutory 540 B.Th.U.), we have then 18,500 BTh.U. As eminent authorities have shown [see "JOURNAL," March 16, p. 673], about 50 per cent. of the heat generated by the combustion of the gas in a modern gas-fire is given off as radiant heat to a room, and about 25 per cent. as convected heat—the balance passing up the chimney, and assisting greatly in the change of the air of the room which Mr. Hills acknowledges is so essential to healthy conditions. This is something the electric radiator cannot do; and, if it could, it could not afford it. But the 75 per cent. of heat sent into a room by a modern gas-fire for a pennyworth of 2s. 3d. gas is equal to 13,875 B.Th.U. for a penny, against an impossible maximum of 6840 B.Th.U. by an electric-radiator, assuming 100 per cent. efficiency, and units at ½d.

Electric Cooker Shortcomings, and Water Heating.

Everything that could be said in favour of cooking by electricity was said by Mr. Hills. Like the engineers who spoke at the recent meeting of the Institution of Electrical Engineers when Mr. Cooper read his paper recounting his personal experiences, Mr. Hills admitted that there was considerable trouble with the hot-plates of electric-cookers; and it is in connection with the hot-plates that there is room for the greatest improvement. They are much too slow; twenty minutes to boil two pints of water, and nine minutes to heat the plate, are conditions that are enough to exasperate a Job. When the advocates of electric cooking are busy trying to influence opinion in favour of their cookers, they invariably, with great circumspection, confine themselves to the work done in the oven. But Mr. Hills, from actual measurement, finds that only approximately one-third of the current consumed is used in the oven and two-thirds are expended on the hot-plate. In the gas industry, it may be calculated (seeing the great extent to which the top plates of gas-cookers are employed for all sorts of things, including water heating) that something like 75 per cent. of the total consumption of gas in the cooker takes place external to the oven. In this connection, Mr. Hills again quoted Mr. Weaving as to costs; that gentleman alleging that there was not much difference between the costs of gas and electricity. We found Mr. Weaving so very untrustworthy in connection with gas-fires, that we are not disposed to place credence in his figures as to gas-cookers. We should want to know much more than he gave as to the means by which the figures were obtained. We hardly think that Mr. Weaving or Mr. Hills would be prepared to accept a challenge to do a corresponding amount of work in an electric-oven and on the hot-plate for the same cost and in the same time as by a gas oven and its hot-plate. It is admitted that the life of electric hot-plates is a variable quantity—some fail within a month, and others of the same make may last for a twelvemonth. Much was said in the paper as to what ought to be done towards assisting in the prevention of breakdowns and other troubles to which the electric-cooker is very susceptible, and the gas-cooker is not; but the points have been so frequently made that there is nothing fresh in them. Attention was also directed by Mr. Hills to the heating of water in bulk by electricity. This also is a matter that has been under discussion lately—most recently in our "Correspondence" columns with Mr. George Wilkinson. Mr. Hills may be interested in this correspondence. The use of gas coke by our electrical friends is an acknowledgment of the inefficiency of electricity for the purpose of water heating in bulk. They would be very foolish if they punished themselves in the matters of time, cost, convenience, quantity, and so forth, by not adopting that which they know is more efficient than electricity. We find gas-generated electricity most convenient for the travelling machinery in gas-works, and so use it. Where groups of stationary machines can be driven by shafting, we know the gas-engine is more economical than the electric motor.

Tariffs and Unreliability.

The members of the Manchester Section of the Institution of Electrical Engineers have had a turn at Mr. W. R. Cooper's electric cooking paper, to which reference has been made in previous "Memoranda." An interesting statement was on this occasion made by Mr. Alderman Walker, of Manchester, which will not be appreciated by the "Point Fives," or, as they have been lately called by one wit, the "Artful Dodgers." A year ago, according to Mr. Alderman Walker, the Manchester Electricity Department adopted a new tariff with the view to attracting a cooking load. The tariff was the ordinary one of 12½ per cent. on rateable value, *plus* ½d. per unit metered. It was also stipulated that houses under £30 should instal 2 KW., £30 to £50 houses 3 KW., and over £50 4 KW. But the alderman had to acknowledge that the response to the tariff was "very poor." The reason for this was investigated; and the only conclusion at which the investigators could arrive was that it was due to the inadequate wiring of houses. We should imagine that some other reasons operated—such as the cost of installation and appliances, expense of maintenance, and the want of reliability, about which the public, by the ordinary conversational circulation of experiences, are getting informed. However, the Manchester Electricity Department is of opinion that the deficient wiring is really at the bottom of the reticence of the public. A note has therefore been prepared by the department for circulation among architects, builders, and house owners, urging them to take steps to ensure that sufficient copper is put into new premises to admit of radiator and cooking loads. Copper costs money; so do gas-pipes. But the difference between the two is considerable. It was also confessed by Mr. E. M. Hollingsworth that at St. Helens, the rateable value system of charging, *plus* a secondary charge of ¾d. per unit, had only been "fairly" successful. The meaning of "fairly" in this connection is not one that is likely to cause much elation, particularly taken in conjunction with what follows. The speaker said that they had to meet the competition of gas at 2s. per 1000 cubic feet; but, in his opinion, there would be no difficulty in doing so were it not for the cost of installing, and the unreliability of, electric-cookers. He instanced the case of a

large works in which, for eighteen months, electricity had been employed for cooking with "every" success, excepting in regard to unreliability. On the question of the rateable value charge, Mr. A. G. Cooper said he found the most equitable primary charge was 12½ per cent. on £15; 15 per cent. from £15 to £30; and 20 per cent. for anything over £30. One other point was made by this speaker; and it was that cooking vessels, especially those made of aluminium, were liable to warp after a time. This is unkind, in view of the imperative necessity of true flat bottoms, in order to maintain perfect contact, if the maximum attainable efficiency is to be secured.

Pursuing the Legal Path.

The Ilford Borough Council are leaving the crooked ways of illegality, and are setting their electricity tariffs in order. It was a drastic measure that was required to bring them to their senses; and the aftermath of their tardy recognition and confession that they had been acting *ultra vires* in respect of undue preference and dealings in electrical fittings, has been anything but pleasant for them. But they have been busily engaged in putting themselves within the bounds of legal authority; and among other matters which perforce have occupied them has been the revision of the charges for electrical energy so as not to further offend by giving undue preference. Whatever is done, however, the Electricity Committee will probably never altogether escape criticism in regard to charges when opportunity offers; for the lesson the members of the Council have had will not be forgotten. The same lesson has also penetrated the walls of many other council chambers. When the new tariffs came before the Ilford Council, objection was raised by one member to the rate—2¼d. per unit—for hotels, public houses, and other premises having equivalent lighting hours. The critic held that in some private houses, current was used over long and similar hours and to corresponding extent; and he maintained that these householders should also be supplied at 2¼d. per unit. The report of the reply of the Chairman of the Electricity Committee as given in one electrical paper seems—if the few lines published are all he had to say—to indicate that this gentleman is somewhat weary of the whole business. He explained that the need for the alteration was brought about by the action of the Gas Company. It is a reflection on the management of the Committee that it required litigation to restore the commercial operations of the undertaking to within the limits of its statutory permission and privileges. However, the Chairman says the hotel tariff is very difficult to reorganize; and there must be consideration for the fact that the hotels have hitherto been the best customers of the undertaking. Evidently the matter was allowed to drop; for the report in our electrical contemporary does not indicate whether or not the critic pursued the argument. It was announced, however, that the Electricity Committee have given instructions to terminate all agreements in respect of wiring, fittings, and apparatus on hire, and also for maintenance.

British Made.

Just as these notes were being written, a gentleman, with nose red (of course, through the then prevailing cold wind) and ancient pipe in mouth, put into the letter-box a circular enclosed in an envelope neatly addressed to the writer. It proved to be from the Corona Lamp Works, Limited, and it contains what is clearly intended for a nasty knock for the largely German capitalized Osram Lamp Works, Limited. We will not spoil the flavour of the circular by any condensation; and it needs no comment, other than that the assumption in the opening words is incorrect, and that the word "them" in the second line distinctly refers to "German-made electric lamps," with contradiction in the remainder of the circular. The document reads:

> You probably buy German-made electric lamps for about 3s. each; why not buy them direct from ourselves, genuine English manufacturers, at 2s. each? On receipt of your instructions, we should be pleased to send you a free sample lamp; and, if you wish it, our electrician will put the lamp up for you in any part of the house. Although Corona lamps are not so well known as many of the widely-advertised lamps exploited in England by people of German origin, a glance at the list of contracts mentioned below is evidence of the quality of Coronas; and, apart from this, every shilling spent in buying a German-made or German-controlled lamp is a direct contribution to the wealth of our country's enemies. We should, of course, prefer to supply you with a sample half-dozen, or a dozen, so that you could give "Coronas" a thorough trial; and we should not ask you to pay for these, unless you were entirely satisfied with them. Should you decide to place a small order with us, you will also have the satisfaction of knowing that you are actively helping an English factory employing exclusively English hands and English capital through this difficult time created by the war now forced on us.

What has the General Electric Company to say to this—assuming the Corona people are driving at the offspring of the G.E.C., the Osram Lamp Works, Limited?

Prohibition of Anthracite Exports.—An Order in Council issued last Friday states that anthracite is added to the list of goods the exportation of which is prohibited to all foreign ports in Europe and on the Mediterranean and Black Seas, other than those of France, Russia (except Baltic ports), Spain, and Portugal.

MODERN ILLUMINANTS AND ILLUMINATING ENGINEERING.*

THE past ten years have seen a marked advance in the study of the principles which underlie the application of light to the uses of modern-day life. The problems of artificial illumination are being attacked from every point, and attention drawn to the nature and development of all light sources, their quality and colour, and the method of their application in the interests of utility, efficiency, and physical comfort.

Progress in research has been rapid, actual practice in lighting work has been quickly developed, and fresh outlets for the lighting expert's enterprise seem speedily to occur. A good deal of information on the subject is now available, since within recent years several books have been published and many articles contributed in "Transactions" of Societies or to the columns of the Technical Press. The general student has therefore a rich field in which to search for knowledge or for suggestive theories; but to facilitate his work and remain fresh in his subject, he must either keep a good index to the varied sources of information, or else replenish his library with books covering the ground required. For the latter purpose, the volume now under consideration will prove a useful addition.

This branch of work, in spite of its comparatively late development, is to-day so comprehensive that the task essayed by the authors, Mr. Leon Gaster and Mr. J. S. Dow, in the compass of 460 pages, has been by no means an easy one. They have apparently realized the difficulty of compressing into chapters materials which have provided other writers sufficient for complete volumes, and have undoubtedly adopted the right course by giving not only the references to their ordinary sources of information, but to those books and articles in which the reader may find the detailed and special knowledge he seeks.

The purpose of the book is avowedly to bring together matter not usually available in a single volume, and to treat the subject on broad lines. Some idea of the ground covered is indicated by the prefatory statement that the initial portion of the book is devoted mainly to the various illuminants, the central portion to photometry and to the effect of light on the eye, and the last part to practical lighting problems. The treatment has been good, and the numerous references and the bibliography at the end make the book an acceptable one. The authors give every evidence of their desire to deal in an impartial way with a subject in which different interests are involved, and with a few slight exceptions they have fairly-well succeeded.

The first chapter is more or less historical, dealing in brief with the transitory stages of illumination down to the conditions of the present day, when the number of illuminants and the diversity of their usage have led to the establishment of the illuminating engineering movement. The authors appear to think that the development necessitates a new specialist, who, as an illuminating engineer, would not only be versed in the science and application of the illumination obtained from varied light sources, but who could also act as an impartial adviser. It is a question whether there will be very many such, even given the time suggested by the authors.

Lighting experts, or illuminating engineers as now phrased, existed before the inauguration of the Illuminating Engineering Society; and they probably represented one or other of the lighting forces. Illuminating engineers, although more numerous and better equipped with knowledge, exist to-day; but the very great majority still represent the side on which they have been trained. Judging by the large number of successful lighting installations, both gas and electric, which are in existence, there is in this no great disadvantage—indeed, the very successes may have been the result of the fact. The Illuminating Engineering Society, some account of which is given in the book, is likely to do very good work, not so much in evolving impartial lighting experts, as in bringing varied interests together on neutral ground for exchange of views, and the knowledge obtained from friendly representation of opposed points of view. Still, one has to agree with the authors, that lighting has so many phases and ramifications, and promises so much in the way of development, that there are "great opportunities for the illuminating engineer."

Three chapters are devoted to descriptions of various types of burners and lamps used respectively in gas, electric, and oil, petrol, and acetylene lighting. While the account of the numerous gas lighting sources is as good as the limits of one chapter will allow, historical sequence is not always observed, and too much importance is here and there given to lighting units which have been tentative rather than practical, or else have virtually fallen into disuse. For instance, after dealing (in a few paragraphs only) with high-power low-pressure lamps, the authors pass on to inclined ordinary incandescent burners, the "Twin-light" burner, and then to self-intensifying gas-lamps; the reader being left with a somewhat vague idea of the relative practical value of the different types.

A general description, with distribution and polar diagrams, is furnished of high-pressure gas lighting systems and the efficiencies obtainable. The authors, in stating the pressure at which gas is supplied to high-pressure lamps, give considerable latitude—

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* "Modern Illuminants and Illuminating Engineering." By Leon Gaster and J. S. Dow. London: Whittaker and Co.; 1915. Price, 12s. 6d.

from 50 to 80 inches—though it should not have been difficult to afford more exact information of the pressure desirable for the purpose.

The authors remark that high-pressure gas has found its most prominent application in street lighting, where powerful units are required. It would only have been right to mention, for the information of the student in illuminating engineering, that the system is also, although not so easily seen, applicable, and as a matter of fact extensively used, in factories, engineering shops, markets, and places of business. In their concluding remarks, they indicate the great possibility of still more efficient gas illuminants than are even now available.

The question of the hygiene of gas lighting with reference to the "possible effects of products of combustion on the temperature, conditions of humidity, and atmosphere of interiors," and the "effect of the illuminant itself on the eyes," all comprehensive enough, is dealt with in eleven lines, and then only to be dismissed with the statements that the matter is "still treated as an open one by controversialists," and that a full inquiry by an impartial and authoritative committee would be helpful. The authors can scarcely claim to be quite impartial, since the phrasing is to some extent suggestive, and leaves an adverse bias in the minds of uninformed readers. This is the more surprising because there are sufficient data furnished by authorities, whose word cannot be impugned, to warrant the authors dealing with the question once it was raised. It is curious, too, to note that the point of ocular effect should be brought up in connection with this phase of illumination, in view (to quote one authority alone) of the statement made, after exhaustive tests, by Dr. S. Rideal, that "ophthalmic experiments were distinctly in favour of gas lighting." No similar references are made in the chapter on "Electrical Illuminants." It is but right to say that the authors give, in a footnote, the reference to Dr. Rideal's work; but it is not every one, unless keenly interested, who troubles to hunt-up sources of information.

The great progress noted in the development of gas illuminants can also be recorded in connection with electric lighting; and the effect of the latter in giving impetus to the evolution of more powerful and effective gas lighting units is seen repeated in the like endeavour of electricians to surpass the later achievements of gas engineers. The authors briefly deal, in Chapter III., with successive phases of carbon and metallic filament lamps, the various arc lamps, vapour, and other electric light sources. Particulars are given of the efficiencies of the several types, much in the same way as was done with gas illuminants. It is remarked that, in spite of the progress of high voltage lamps, a 100-volt lamp will, in general, give better results than 200-volt lamps of the same consumption; the useful life will be better; and the filament will be stronger. The authors note that high voltage low candle-power lamps work at a consumption nearer 1·5 than the usually stated 1·2 watts per candle.

According to the authors, the metal filament lamp has also been the means of stimulating interest in illuminating engineering, since the gain in efficiency has led people to acquiesce in the desirability of effective shading—the loss of light being now of less consequence.

A reference is made in a short paragraph—the main part of the chapter having already been written—to the claims of the so-called half-watt metallic filament lamp; but there were not sufficient data at the authors' disposal to do more than enumerate the possibilities and hopes entertained as to its future. The same method of description is followed with reference to arc and vapour lamps; and the pages include a useful table of the results to be obtained from the particular types of light sources employed. The candle power figures for arc lamps are all in mean lower hemispherical terms; but these might have been usefully supplemented by maximum and minimum candle-power values.

It may be unnecessary to do more than shortly notice the chapter on oil, petrol-air gas, and acetylene lighting, since, while properly included in the book, these methods of lighting have an application principally limited to country districts. The student will, however, find sufficient material for a general knowledge of the systems in use, should special requirements call for them. Certainly wonderful progress has been made in this as in the major fields of illuminating work.

One is inclined to think that the authors have found themselves happiest in the chapters dealing with general illumination, and with colour in relation to the eye, as is suggested by the excellence of the information provided. As they say, "it is to the eye that the ultimate appeal in illuminating engineering must always be made" and the question has evidently been deemed of such importance, altogether apart from its intrinsic interest, that they have written both fully and suggestively.

The construction of the human eye and the amount of illumination necessary to see detail and to perceive light and shade are adequately dealt with. The connection between illumination and acuteness of vision has been the subject, within recent years, of various practical investigations; and the authors reproduce data and curves which go to suggest that an increase in illumination beyond 2 to 4 foot-candles produces very little increase in acuteness of vision; while a drop to less than 0·5 foot-candle means a very rapid diminution in the power of perception. It is pointed out, therefore, that, except for special work, 3 to 4 foot-candle illumination is sufficient to bring the eye to a fairly stable condition. Very much the same thing would appear to happen where colours are concerned, since at low illumination the "Purkinje effect and other oddities of colour-vision become accentuated"—brightness of the blue rays appearing, for instance, greater than (say) of the red—and the stable state of things is arrived at when 3 to 4 foot-candle illumination is provided. This is to be remembered, in view of photometrical testing of different lights under low conditions of illumination.

Illumination in great excess produces a dazzle which leads to a diminution in acuteness of vision; and this observation, made by Koenig and Brodhun, opens the way to the consideration of the effect of violent contrast and glare. The authors make some useful notes on both subjects. So far as the latter is concerned, they repeat the well-known fact that the impression of glare depends, to a great extent, on the intrinsic brilliancy of the light source; and they therefore give a table of the brilliancy data of various illuminants.

Some authorities have argued that the candle flame, having an intrinsic brilliancy of 2·5-candle power per square inch, is about as much as can be observed with comfort at close quarters; and as this brightness is about the same as the average sky, to which our eyes have presumably been developed, the authors suggest this as one reason "for fixing the minimum permissible intrinsic brilliancy near 2 to 3 candle power per square inch." Seeing that they also say it should not be difficult to keep intrinsic brilliancies of exposed light sources down to this value, this at first reading does not appear to be very clear. If the authors mean that the intrinsic brilliancy of the light source should not exceed 2·5-candle power per square inch, many illuminants would be ruled-out which, even with their higher values, do not err greatly on the side of excess; and adequate illumination, as a result, would become both complicated and costly. It would seem, however, that the remark refers simply to those light-sources which cannot be kept out of the direct range of vision, and, yielding more than the values stated, should be toned-down by opal or similar shades.

The remainder of this chapter is devoted to the effect of coloured light on the eye, though the subject has later on a special chapter to itself. In opening, it is stated that claims are not infrequently made for one or another illuminant that it is less trying to the eyes than its competitor, but that these claims are frequently of a vague and misleading character.

The authors, so far as electric lighting is concerned, suggest that the complaint originates rather in the misuse of bright electric filaments, than to any defect in the quality of the light itself. The remark has probably a good deal to justify it; but after their first general statement that the colour constituents of the spectrum octave of vibrations 0·4 μ (extreme violet) to 0·8 μ (deep red) are really present in varying degrees in artificial illuminants, and their general remarks on the effect of colour rays on animal and vegetable life, it would not be at all surprising if the reader finished the chapter with the impression that there is something after all in the suggestions made. The impression is perhaps deepened by the references made to the tendency to richness in ultra-violet light on the part of modern illuminants of great intrinsic brilliance, to the bad effect of some arc lamps, and to the introduction "Euphos" glass for the absorption of ultra-violet and the neighbouring rays.

(To be continued.)

THE CHOICE OF EMPLOYMENT.

With the praiseworthy object of assisting to solve the old problem of what to do with our boys (and girls), a series of about twenty pamphlets were arranged for by the Board of Trade. The idea really is that the pamphlets should serve as guides to members and helpers of Advisory Committees for Juvenile Employment in Greater London, in connection with their work of advising boys and girls as to the choice of suitable employment. There has been no effort to compile a scientific or even a complete study of the different trades; and the intention is that the information furnished should be supplemented to meet individual and local requirements by reference to a Labour Exchange or Juvenile Employment Bureau. One of the pamphlets already published has reference to the "Gas and Electricity Supply Trades;" and to it is appended a notification to the effect that the handbook was written before the outbreak of the present war. The conditions described are those prevailing in the trades in normal times. They do not, therefore, necessarily represent those prevailing during the present disturbance.

In the different districts of the Administrative County of London, the distribution of the gas and electricity supply trades can be gathered from figures given in a table compiled from the factory and workshop returns. From this it appears that of the total number of persons engaged in these trades, Camberwell is responsible for 22·5 per cent., Greenwich for 11·5 per cent., and Westminster for 12 per cent. These are the three highest figures. A short description of the process of gas manufacture is included; and dealing with the retort-house, it is remarked that, as the regulations of the Factory Acts prevent boys under eighteen being employed on the night-shifts, comparatively few juveniles are engaged in this part of the works. Indeed, those under twenty years of age form only about 5 per cent. of the total workers; and they are not employed in the actual carbonizing work. As to the method of entry, the information is given that a few boys start as errand boys, while others enter the gas-works at sixteen and begin

at such work as sorting clinkers, &c., until they are old enough to go into the retort-house.

Then there is gas supply (of which some particulars are also furnished), in connection with which, we are told, gas-fitters are in some cases apprenticed for three years, and taught in a special shop; while collectors, &c., are sometimes recruited from office boys. The compiler has, however, thought it well to add a warning that "throughout the gas-works service the sons of employees are given a preference, and the trades are to some extent hereditary." A list of average rates of wages for a full week's work is given; and brief reference is made to hours and holidays. The Earnings and Hours Inquiry (1906), it seems, returned the average hours of gas workers in a full winter week for London as 51·4. That the gas trade is, on the whole, healthy is indicated by the fact that in the Registrar-General's report for England and Wales the comparative mortality figure of those engaged in gas-works service is shown to be, in the main working period of life, 13 per cent. less than the standard for all occupied and retired males.

Under the heading of suggested educational courses, mention is made of the fact that there is now a definite scheme of co-operation with the London County Council for the educational training of boys; day classes being held for the purpose at the Westminster Technical Institute. Boys are recommended to attend an Evening Junior Technical Institute for a gas-fitting and plumbing course; and this should be followed by attendance at a Technical Institute for courses on gas supply and gas manufacture. In 1911, there were 8041 males returned as engaged in gas-works service in London; and of these 84 were between fourteen and seventeen years old. Under the heading, "Prospects and General Considerations," it is rightly pointed out that the production of gas is a seasonal trade; and the writer adds: "The prospects of a boy in the gas industry are good. Though the introduction of machinery has recently diminished the demand for retort-house workers, the increase in consumption has counterbalanced this loss, and in other departments has increased the openings for workers. Permanent employees also have in many cases the advantages of profit-sharing schemes and pension funds."

With regard to electricity supply, the information given is on the same lines. At the census of 1911, it is stated, the number of males engaged in this industry was 2809, of whom 55 were between fourteen and seventeen years old. Readers are warned that there is some element of danger in most of the electrical trades; accidents being usually due to inadequate insulation of live wires, conductors, &c., or to carelessness or ignorance on the part of employees. In 1912, there were 334 non-electrical and 58 electrical accidents at electricity stations.

COKING AND BYE-PRODUCTS.

By "Event and Comment."

Pit-Head Power Stations.

There is a tendency in this country towards the centralization of power stations, and, indeed, towards the establishment of pit-head power stations, where the fuel shall be consumed at a place where it is produced, and thus save considerable sums in carriage. This idea has been adopted in connection with several bye-product coke-oven plants. In Durham, a company, known as Waste Heat and Electrical Generating Stations, Limited, has made an arrangement whereby the waste heat from several coke-oven plants is taken over at an agreed figure, and used for purposes of power production.

In Yorkshire, the Yorkshire Electric Power Company have erected a power station in conjunction with the bye-product coke-ovens of the Old Silkstone Colliery Company, and surplus gas from the coke-ovens is ultimately employed for the production of electricity. The whole of the current required at the colliery is supplied from the Power Company's plant; and the current is also supplied in the surrounding district. The principal advantage of such an arrangement as this, as against the establishment by the Colliery Company of their own power station, is that all fluctuation in load is taken up by the Power Company, and hence the maximum efficiency is obtained; and as the coke-oven plants are continuously at work, there is the continuous production of surplus gas.

There are, however, times at all collieries when the surplus gas cannot be used, especially at the week-end. Consequently, during these periods the gas has to be wasted, or at any rate only partially utilized. With the arrangement with the Power Company, on the other hand, the full supply of gas is taken by this Company all the time it is available; and they take the responsibility of any fluctuation in their load. The responsibility of the power station is also taken out of the Colliery Company's hands; and they are reasonably assured of a continuous supply of current made under the best circumstances and under expert supervision—thus reducing the possibility of a breakdown to the absolute minimum.

There is a great tendency in many collieries to go in for the establishment of gas-producers working under recovery conditions, and utilizing the producer gas formed for boiler-firing purposes. The efficiency of gas-fired boilers is beyond all question; and this system easily lends itself to colliery conditions. Gas-producers are now-a-days very efficient machines, and can deal with almost any class of fuel containing up to as much as 40 per cent. of ash. Naturally, of course, the more inferior the fuel the less is the yield of bye-products, but also the smaller is the cost of the fuel. This proposition also appeals to collieries without coking coal; for non-coking coal is very suitable for use in gas-producers, and if the object is the production of power, producer gas is very well suited for use in gas-engines.

Choice of Producer Plant.

It is interesting to review the principal points which have to be taken into consideration when contemplating the erection of a gas-producer plant. There is no difference in the principle underlying the operation of all types of gas-producers; but there is a wide difference between the structure and design of the various types. One of the principal factors towards the success of a gas-producer installation is the use which can be made of the gas produced. In South Africa, a large installation has been erected, the gas from which will be almost entirely wasted. Fortunately, however, the coal contains a very high percentage of nitrogen; hence the yield of ammonia obtainable more than balances the loss of revenue on account of the waste of gas. The nitrogen content of the fuel is perhaps the most important factor, as the yield of ammonia resulting from it is the principal source of revenue on a producer plant. The coal needs to be of a suitable nature for gas-producer work; and almost any class of carbonaceous material can be dealt with. If the coal is low in ash, an ordinary water-luted bottom producer is quite satisfactory; but if the ash content is high, then a producer with automatic ash discharge is perhaps better suited for the work. The size of the fuel is also important. If it contains an undue proportion of fine material, trouble is experienced owing to the large amount of dust which is carried forward with the gas; and fine material also offers considerable resistance to the blast.

Ammonia.

Until quite recently, it was generally assumed that about 2½ lbs. of steam was required for each pound of fuel gasified under recovery conditions. It is well known, of course, that ammonia is a comparatively low temperature product, and that if the temperature rises above about 800° C. the ammonia undergoes rapid decomposition, and there is a correspondingly large decrease in the yield of sulphate of ammonia. The object of adding so much steam to the blast is to keep down the temperature inside the producer, and so prevent the decomposition of ammonia. This question has received much attention in recent years, and many experimenters have attempted to discover the best conditions for the production of the maximum yield of ammonia, while at the same time reducing the steam consumption to the lowest possible limit. It is claimed with one type of producer that, in order to obtain the maximum yield of sulphate of ammonia, not more than 1 lb. of steam per pound of fuel is required. This, of course, represents a considerable saving over the old type of producer; and if the claim can be justified, then the system should receive substantial support.

If a bituminous coal is used for producer gas manufacture, particularly under recovery conditions, a considerable quantity of tar is produced. Unfortunately, owing to the large quantity of steam employed, this tar often contains a very high proportion of water; thus rendering it more difficult to deal with. On a tar distilling plant the difficulty, however, in dealing with the water can be got over, and from the tar are obtained creosote oil and a very good quality of pitch. Modern producers can be adapted to gasify inferior coal, and in some cases a mixture of coal is employed. In America, a great deal of experimental work has been carried out in connection with the mixing of coal, both for use in bye-product coke-oven plants and also in producer plants. It is quite possible to gasify a mixture of small coal and coke breeze, or any other inferior or cheap class of material. With the development of types of coke-ovens which can be heated by producer gas, the whole of the coke-oven gas is available for other purposes. This method of utilizing inferior or waste material is worthy of the attention of colliery proprietors.

Dye-Stuffs.

The establishment of British Dyes Limited is now an accomplished fact, and we may expect in the near future some development in the industry of the manufacture of synthetic dye-stuffs in this country. The question has aroused a great deal of interest, not only in the technical world but also in the minds of laymen; and almost everyone who is associated in any way with the production of coal tar products has taken a personal interest in the matter from the point of view of being himself a possible producer, either of the raw materials, the intermediate products, or the synthetic dye-stuffs themselves. The raw materials used are principally benzene, toluene, naphthalene, anthracene, and phenol, and through these, by means of various chemical reactions, are produced intermediate compounds. In this way, commencing with a few substances of comparatively simple composition, and whose constitution is thoroughly well understood, a very large number of intermediate products are obtained; and by the development of these bodies a still larger number of dye-stuffs are produced. It is hardly to be hoped that either gas-works or coke-oven plants can themselves manufacture the synthetic dye-stuffs; they will be confined in most cases to the production of either the raw materials outlined above, or, at most, to the manufacture of some of the simpler intermediate compounds.

Another point which has to be borne in mind is that many of the reactions by which both intermediate products and finished dye-stuffs are manufactured are carefully protected by both English and Foreign patents, and that it will mean years of work

to discover alternative methods to supplant the existing means of manufacture. It has to be remembered that the German chemists have been well organized, and have been working on set lines for a very considerable period, and that the above-mentioned processes have been evolved by them as a result of long and arduous work. It follows naturally, therefore, that they have already probably discovered the more easy and simple ways of manufacturing the dye-stuffs, and, consequently, the newer processes or alternative processes will be correspondingly more difficult to elaborate.

It will be agreed, therefore, that for the present, at any rate, coke-oven people would be better advised to confine themselves to the production of the intermediate products. For these, pure benzene, toluene, &c., are required; and the first step must be the installation of plant for producing these bodies to the requisite degree of purity. For the production of the intermediate bodies five distinct types of reactions are generally employed; and it is in connection with these reactions that further development in the general chemical trade in this country will be required. These reactions might be grouped under the following heads: (1) Sulphonation, (2) alkaline fusion, (3) nitration, (4) reduction, (5) alkylation.

No doubt the most attractive of these to the coke-oven man will be groups (3) and (4)—that is, the production of the nitro-compounds of the hydrocarbons, and the reduction of these nitro-compounds to the corresponding amines, such as aniline, toluidine. In this connection, also, the manufacture of explosives, such as trinitrotoluene, picric acid, &c., might also be deemed to be worthy of attention.

COKE-OVEN GAS FOR TOWN PURPOSES.

By "Amicus."

A very interesting paper was read before a recent meeting of the Indiana (U.S.A.) Gas Association, on the "Application of Bye-Product Coke-Ovens to the Gas Industry,"* in which the author dealt with the utilization of coke-oven gas for town purposes. The whole of his conclusions were, of course, based upon his own experience under American conditions; and before comparisons are made it is very important to know that similar conditions do not apply in this country. In America coal-fires for domestic purposes are comparatively unknown; the central heating system being adopted. This means that either coke or anthracite coal is preferred for domestic purposes, and, moreover, that coke produced in bye-product coke-ovens can be equally well employed for this purpose. At the outset, therefore, this puts bye-product coke-ovens in America upon an entirely different footing from those in this country. In America they are in direct competition with the gas companies for the sale of their coke; whereas in this country there is absolutely no competition whatsoever between bye-product coke-ovens and gas companies, with perhaps the exception of the coke-breeze, and this is altogether insignificant.

There are two aspects of the question which are not always dissociated; and it is on account of such omission that much confusion is likely to arise. In one case coke-ovens can be expressly built for the purpose of gas production; and while the coke in no way differs from the ordinary metallurgical coke produced by bye-product coke-ovens, yet special devices are adopted for ensuring the production of a high yield of good quality gas which can be used for town purposes. In such cases the gas is of as much importance as the coke. A plant of this type has been erected by the Birmingham Gas Corporation Department, and is entirely in their hands. In the second case, however, the type of plant referred to is purely a bye-produot coke-oven installation—that is to say, the primary object is the production of metallurgical coke, and also, as far as is compatible with this, the obtaining of the highest possible revenue from the bye-products, including in these the surplus gas.

As already pointed out, this distinction does not apply in America to the same extent as it does in this country; and in making any general conclusions this is the outstanding fact which has to be borne in mind. In some respects the conditions in America are more severe, because in many instances the coke-oven gas has to compete with natural gas having a calorific value of at least 600 B.Th.U. per cubic foot. Consequently, the coke-ovens must produce a gas of very good quality; and if this quality is to be maintained, the benzol must not be extracted from the gas. Owing to the comparatively cheap supplies of petroleum products which have been available in the past in the United States, there has been little incentive to recover benzol from coke-oven gas. Now, however, things are changing, and largely perhaps on account of the situation with regard to the supply of dye-stuffs. Americans are now turning their attention both to tar distilling and benzol recovery, and during the past twelve months a considerable number of tar distillation and benzol recovery plants have been erected in connection with bye-product coking installations.

Development in America is continually proceeding at a very rapid rate, and many of the ideas of development there have been the result of investigations made by accredited representatives in Europe, and particularly in Germany. In many cases when a new district has been opened-up coke-ovens have already been in operation, whereas no gas-works have been existent; in other cases, small gas-works have been at work. The town has developed very rapidly (more so than the gas-works), and, moreover, bye-product coking has also developed to an enormous extent. Here then, we have the most favourable conditions for the employment of bye-product coke-oven gas for town purposes. In the first instance, the alternatives are: (1) The utilization of the surplus coke-oven gas from the existing coke-oven plant; (2) the erection of complete new gas-works.

Now it is not an expensive nor a difficult matter to increase the output of a bye-product coke-oven plant, as it is quite a simple matter to add a few ovens to an existing battery. In this way, therefore, comparatively cheap supplies of gas can be obtained without much in the way of new capital outlay. In the second case, to bring the existing gas-works up to the standard means also considerable capital outlay; while the new bye-product coke-oven plant which is being erected can, at little or no extra expense, modify the plant in order to produce a suitable quality of gas for town purposes. If, therefore, the township can come to an arrangement with the coke-oven people to make such modification, it is to their interest to do so. Consequently, all the factors are in favour of the adoption of coke-oven gas for town purposes.

Looking at the matter from the point of view of this country, one finds that in most cases the conditions are the exact opposite to those obtaining in America. Most gas-works have been in existence for a considerable number of years. Moreover, the plant is kept thoroughly up-to-date, and is quite easily capable of meeting all the requirements of the district. New towns are not constantly springing up in this country, and, consequently, we have not such development as is met with in the industrial localities of America. We are also far more tied down by prejudices and red tape than our American brethren.

The writer cannot call to mind more than one or two cases in which there is any advantage in even considering such an arrangement between coke-oven people and town-gas works that would in America present a very favourable case for amalgamation. The advocates of coke-oven gas in this country—mainly, be it admitted, interested parties—never advocate arrangements such as those adopted in America. They are principally out of court on account of the coke question. What is advocated is either the erection of plant such as that at Birmingham, which has a definite object of producing metallurgical coke for consumers of this commodity in the Birmingham gas supply area or the bulk supply of surplus coke-oven gas from coke-ovens to gas-works, without suggesting the complete dismantling of existing gas plant.

Very few coke-oven people are in a position to take upon themselves the responsibility of guaranteeing a continuous gas supply in case of strikes, &c. There is no doubt, however, that if this is necessary the coke-oven people are in a position to do it equally as well as the gas engineer. It is merely a matter of having sufficient coal kept in reserve. There is, however, still the question of the coke; for if this difficulty came at a time when coke was a drug on the market, there would probably be a fairly substantial loss by having to make coke solely to keep up the supply of gas. Exactly the same reasoning, however, applies to the proposition when in the hands of the gas engineer; so that this should not prove to be a vital stumbling block. At Middlesbrough, provision is made for this by the fact that the Middlesbrough Corporation have in reserve a carburetted water-gas plant, which is almost equal to supplying the whole of the gas required if necessary. There is, moreover, a further safeguard in the fact that the firm from whom the coke-oven gas is bought in bulk work a considerable number of coke-ovens; and not more than one-fifth of these probably are quite sufficient to produce the whole of the gas required for Middlesbrough. There is therefore a considerable margin of ovens which can be put out of operation in case of necessity before the gas supply is interfered with at all.

The most reasonable proposition, and the one which is more generally advocated, is that some of the surplus gas from existing coke-oven plants which is not being used at present to the best advantage could quite well be sold to gas companies in the vicinity of the coke-ovens, thereby reducing the amount of coal carbonized by the gas companies. Mutually advantageous terms should not be difficult to arrange; and the question of continuity of supply need not necessarily come into the matter at all.

* The paper appeared in the last number of the "Journal" (p. 81), and was dealt with editorially in the same issue (p. 65).—Ed. J.G.L.

The "Journal des Usines à Gaz."—It may be remembered that on the outbreak of the war the publication of our French contemporaries ceased. In addition to the difficulties attendant on their production, the "Journal des Usines à Gaz" sustained a great loss in its administrative department by the deaths of MM. Delahaye and Monnier, noticed in our columns at the time. The issue ceased on the 5th of August; as the number for the 20th, which was ready, could not be sent to subscribers owing to the derangement of the postal and transport services. Eight months after the cessation of publication, the "Journal" has now re-appeared. The issue for the 20th of August came to hand recently; and we have since received a number intended to cover the remainder of the series from Sept. 1 to Dec. 31, 1914. The first number for the present year will be dated the 15th prox.; and an endeavour will be made by the administration to compensate for the interruption in the publication which was forced upon them by insurmountable obstacles.

THE BANCROFT-HANSFORD RETORT-CHARGER.

Advantages of Filled Retorts.

By means of an announcement which has appeared from time to time in another section of the "JOURNAL," readers have been made acquainted with the fact that the Guest-Gibbons stoking machine as now supplied embodies the patented improvements of Messrs. Bancroft and Hansford; and the nature of the improvements was indicated by the illustrated abstract of the patent specification in our issue of Jan. 5 last [p. 37]. The apparatus is the invention of Mr. F. J. Bancroft, the Engineer and Manager of the Barnet Gas and Water Company, and Mr. J. B. Hansford, his Assistant at the Barnet Gas-Works; and its object is to enable the retort to be filled substantially completely with coal, in one, two, or more operations, and the coke to be pushed out at the farther end. The members of the London and Southern District Junior Gas Association who were fortunate enough to take part in the visit to the Hornsey Gas-Works last Saturday week, had an opportunity of examining, and having fully explained to them by Mr. J. W. Buckley, the Bancroft-Hansford improvement; but as it had only just been added to the Guest-Gibbons machine there, Mr. Buckley was unable to quote figures from his own experience. Near by, however, at the Barnet Gas-Works, stoking machinery on this principle has, under the supervision of the patentees, been in use for over nine months; and an inspection of it amply satisfied the writer that it successfully accomplishes in every-day practice what is claimed for it—that is to say, it substantially fills the retort with coal. With regard to the advantages thereby obtained, Mr. Bancroft is in a position to submit records of results which speak for themselves.

In a few words, this method of charging consists of the provision of a trough, which can be moved close up against the mouth of the retort; and over this trough is a shoot connected with a coal-hopper on the machine, having at the lower part an automatically operated door. At the bottom of the trough is a moveable tray-plate, which, during the charging, is pushed along, coal meanwhile falling upon it to approximately the level of the top of the trough, until the end of the plate comes under the shoot, when the door is automatically shut. On the plate (with its charge) reaching the desired spot in the retort, it is withdrawn, a stationary head behind at the same time pushing the coal off on to the retort-floor. The number of "shots" taken to charge a retort can be regulated, and the placing of the coal accurately controlled, so as to prevent jamming. For a 20-foot retort, three or four "shots" are the usual practice. In discharging, the head and tray-plate are pushed into the retort together—the latter then, of course, not projecting beyond the head.

The application of the Bancroft-Hansford patent to the stoking operations at the Barnet Gas-Works has, in the first place, resulted in a larger yield of gas per ton and per mouthpiece—four benches of nine retorts having, in this way, taken the place of five benches. Using South Yorkshire nuts, the make of gas per ton was 14,094 cubic feet with hand-charging, and 14,130 feet with the original Guest-Gibbons type of machine; while with the Bancroft-Hansford improvements it is 14,676 feet (the quantity sold per ton, it may be parenthetically remarked, being 13,355 feet, of a calorific value of about 520 B.Th.U. gross). The figures for yield of gas per retort are respectively 14,488, 15,150, and 17,000 cubic feet. With hand-charging, the weight of coal placed in the retort was 7 cwt., and eight-hour charges were the custom. But when the Guest-Gibbons machine was installed, the weight of coal was increased to 9 cwt.; the duration of the charges being twelve hours, with eight hours for the centre retorts. Under Bancroft-Hansford conditions, also, twelve-hour charges are worked, but with ten hours for the middle retorts; while the weight of coal placed in the retorts has been increased to 12 cwt. The retorts, it should be added, are 20 feet by 22 inches by 16 inches. In former days there were 24 stokers employed in the house; whereas now the number is only eight.

The advantages of the new arrangement are, however, by no means confined to gas-making considerations pure and simple. The coke has been much improved, being closer and harder; and the tar is extremely thin and liquid, with no "free-carbon" in it. The gas has also been rendered practically free from naphthalene deposit, having a greater quantity of light oils, while less carbon is found in the retorts. As to the retorts themselves, it seems reasonable to suppose that, inasmuch as the whole surfaces are cooled at the same time, they should, as compared with partially-filled ones, have a greater life, owing to equal contraction throughout. One other point is that the percentage of fuel used is considerably decreased.

These few notes (which are by way of supplement to the demonstration with the apparatus at the Hornsey Gas-Works, as mentioned in the "JOURNAL" last week) will be sufficient to show the striking character of the results which have been secured with the invention by the patentees at the Barnet Gas-Works.

The annual general meeting of the Scottish Junior Gas Association (Eastern District) will be held in the Heriot Watt College, Edinburgh, on Saturday next, when the annual report of the Council and the accounts will be submitted for adoption. Then the election of office-bearers will take place. Afterwards a short paper will be presented for discussion, by Mr. J. J. Scott, entitled "Are we Shop-keepers?"

THE KEITH PATENT GAS-IRON.

A Useful Domestic Appliance.

For reasons which it is altogether unnecessary here to specify (for by now they have very generally impressed themselves upon the nation), economy is at present being even more widely studied than has been the case hitherto; and this is a state of things which is likely to last for some time to come. The results of this wider study of what to the majority of people is a distinctly uninviting subject, are already to be seen in many directions; and, among other things, it appears only fair to assume that, when outgoings are being reviewed, the laundry bill will come in for a share of attention. In other words, and to put the matter baldly, more washing is likely to be done at home—for it is not intended to suggest that economy will be carried so far as to dispense with it altogether. This should add greatly to the existing large field for the domestic gas-iron—an appliance which, for one reason or another, has not so far been adopted to anything approaching the extent that it might be.

Therefore the moment is particularly opportune, from the point of view of gas undertakings, for introducing a new appliance of the kind, possessing all the qualities requisite to make it a household favourite. Of such a character is the Keith patent domestic gas-iron, for connection to the ordinary low-pressure supply. In view of the name with which it is associated, it is hardly necessary to say that this is an iron that has been constructed on scientific principles; but at the same time it should be emphasized that its manipulation is a matter of extreme simplicity. There is no complication anywhere; and the form of construction is all against trouble from lighting-back. In the matter of appearance (even in these utilitarian days undoubtedly a point to be considered, though the exact measure of its importance may be hard to determine), the iron, with its plated bottom portion, leaves nothing to be desired. It might almost be mistaken for an electric iron—until the bill for consumption of power came in! The weight is just about right—5 lbs.; and so well-balanced is the appliance that, when grasped by the handle, it does not seem to be even so heavy as this. Consumers will, of course, in striving after economy, consider the gas bills as well as their laundry bills; but, in doing so, they will certainly conclude that there can hardly be a cheaper way of doing their ironing than by the use of a thoroughly efficient gas-iron consuming about 3 cubic feet per hour. In laying stress upon the economical aspect of dealing with the household linen, it is desired that economy should not be confused with cheapness; for, as everyone knows, the two words do not necessarily mean the same thing. The claims of the Keith gas-iron are not urged on account of cheapness in first cost. It is placed on the market as a really high-class article, and as one which will prove a thoroughly good investment.

Examining the parts of the iron, and taking first the gas-nipple, this is supplied of a size to suit the gas in the particular area in which the iron is intended to be used, or an adjustable nipple may be had, if preferred. Should, however, the wrong nipple for the pressure and quality of gas be fitted, it is a matter of a moment to remove and replace it. There is no provision for a supply of secondary air to the iron; a narrow slit round the bottom being merely to allow the products to escape. The gas-injector carries the necessary air for complete combustion with it into a tube running along the top inside the iron. In this tube, which is on the Venturi principle, the mixture takes place, flowing afterwards into the body of the iron, over an asbestos pad. At the outlet of the tube, a set-screw adjustment is provided, in case the gas should be drawing in more than the requisite amount of air. Having reached, and spread itself over, the asbestos pad, the mixture passes evenly through a series of holes, at equal distances from each other, on to the burner proper. This burner takes the form of a metal grid of nearly the same surface dimensions as the body of the iron; and over the whole of this the gas burns with a very thin flame—the heat being taken up by a series of projections over the sole plate of the iron.

This short explanation of the construction of the iron suggests—what the writer has found to be actually the case—that the bottom of the iron would be evenly heated throughout its surface, which is an important point with a gas (or any other) iron. With proper adjustment, sooting-up and smell are absent; while as for noise, so silent is the appliance in action that it is desirable, after applying a match to the narrow slit at the back of the iron, to make quite sure by inspection of the orifice that the gas has ignited at the burner.

With so many things in its favour, it is hardly surprising to learn that much satisfaction has been expressed by gas companies who have tested the Keith gas-iron. It should prove a good, if individually small, gas user.

Prizes are being offered by the Russian Ministry of Finance with the view of stimulating research in the preparation of denatured spirit for industrial uses. Four prizes of £7500, £5000, £3000, and £2000 are offered for an invention or improvement relating to apparatus for utilizing spirit in internal combustion engines, and a like number of £5000, £3000, £1500 and £500 for an invention or improvement relating to apparatus applying spirit to lighting purposes. Competitors must send in their proposals not later than Jan. 1 next year, accompanied in every case by samples.

PROFESSOR FRANKLAND ON THE CHEMICAL INDUSTRIES OF GERMANY.

Brief reference has already been made in the "JOURNAL" to a paper read by Professor PERCY F. FRANKLAND, F.R.S., at the meeting of the Birmingham Section of the Society of Chemical Industry early last month. The full text of the paper appears in the current number of the Society's "Journal," and we extract therefrom the portions bearing upon matters specially interesting to our readers.

In his introductory remarks, the author called attention to the remarkable fact that the Royal House of Prussia has during many centuries been associated, in one way or another, with chemical enterprises of different kinds. Thus the second ruler of the country, the Markgraf John (1608 to 1619) was actually surnamed "The Alchemist," in consequence of the zeal with which for many years he pursued his investigations on the transmutation of metals. The Great Elector (1640 to 1688) was a patron of chemistry. Coming to later times, the manufacture of phosphorus by electro-thermic means was introduced at Frankfort in 1892. Having shown how various industries owe their origin to Germany, the author offered the following remarks on

INDUSTRIES CONNECTED WITH ARTIFICIAL ILLUMINATION.

The world is greatly indebted to Germany for inventions which have largely revolutionized artificial illumination—firstly, in connection with gas, and more recently in respect of electric lighting. Thus, one of the most remarkable discoveries in this domain was that of incandescence gas lighting, which was made by the Austrian Count Dr. Carl Auer von Welsbach, of Rastersfeld in Styria, as the result of lengthy, laborious, and ingenious researches. The now so familiar gas-mantles are prepared by the ignition on the cotton frame of a mixture of 99 per cent. of thorium nitrate and 1 per cent. of cerium nitrate. The source of these rare earths is monazite sand, the elaboration of which has become a very important industry, depending on fractional crystallization, which already many years ago was brought to such a high pitch of perfection in the laboratory of Sir William Crookes. Out of this sand, Otto Hahn, in 1910, succeeded in extracting mesothorium; and the process is carried out on a large scale at the works of Dr. O. Knöfler and Co., at Plötzensee, near Berlin. Radium bromide is worth about £17 a milligramme, and mesothorium about £7 10s. The mesothorium is present in the monazite sand in only extremely small proportion—about one part in 150 million parts of the mineral. I may also refer to Auer-metal—a preparation of iron (Fe 30 per cent.) containing cerium, which sparks when scratched with hard steel, and which is familiar as a substitute for matches.

In 1903, the Auer Company showed that the carbon filament of incandescence electric lamps could be replaced by an osmium filament, with an economy of 50 to 60 per cent. of current. In 1905, Siemens and Halske showed that a tantalum filament was cheaper and more advantageous, and in 1906 that the tungsten filament was even still better. Tungsten occurs in sufficient quantity in Nature as wolframite (iron tungstate) and scheelite (calcium tungstate) to enable the metal to be now sold as filament metal for 6s. to 7s. a kilogramme.

Some idea of the enormous and increasing scale on which the incandescence lighting manufacture is carried on in Germany may be gathered from the following figures:—

—	1911.	1912.
Metallic filament electric lamps	47,211,892 pieces	76,185,721 pieces
Carbon filament electric lamps	24,791,196 ,,	20,975,348 ,,
Incandescence gas-mantles. .	126,050,954 ,,	135,320,173 ,,
Arc-lamp carbons	10,740,025 kilos.	11,093,154 kilos.

According to Professor Vivian B. Lewes, the consumption of mantles in 1912 was: Germany, 100,000,000; America, 60,000,000; England, 38,000,000; France, 16,000,000; Belgium, 3,500,000; Italy, 3,000,000; Russia, 1,500,000.

The special tax imposed in Germany on lighting apparatus realized from the above sources in 1912 was £800,000. This remarkable tax was one of those extraordinary financial expedients resorted to by Germany during recent years to provide the wherewithal for the stupendous national effort to subjugate Europe of which we are the witnesses to-day.

AMMONIA.

Of the commoner inorganic chemicals which are produced on the largest scale, one of the most important is ammonia, which has for so many years been obtained as a bye-product in the manufacture of coal gas. So backward was this industry in Germany, that actually even as late as 1874 the ammoniacal liquor from their gas-works was run to waste. All the more remarkable is the state of affairs to-day, as betrayed by the following figures. The world's production of ammonium sulphate was 210,000 tons in 1890, 500,000 tons in 1900, and 1,330,000 tons in 1912. Germany's production of ammonium sulphate in 1912 was about 370,000 tons.

Production of ammonia by the Haber process has been carried out on a commercial scale by the Badische Anilin Company since the summer of 1913, and a plant capable of yielding 130,000 tons of sulphate of ammonia per annum was to have been ready during the present year. Inasmuch as the German Colour Syndicates have severed their connection with the Norwegian nitre undertaking, it would appear that they regard the Haber ammonia process as being more likely to be capable of capturing the inorganic nitrogen market of the world.

This synthetic production of ammonia obviously involves cheap hydrogen; and there are cheaper sources than the electrolytic one. Thus water gas contains theoretically equal volumes of hydrogen and carbon monoxide; and the carbon monoxide can be removed by liquefaction from the hydrogen. Similarly the nitrogen required for the process is obtainable from the fractional distillation of liquid air. The synthesis of ammonia thus dovetails with the possibilities of cheap low-temperature production, for which the world is so largely indebted to the German engineer, Carl von Linde, of Munich.

The German ambition to make their combined nitrogen at home does not stop at the production of synthetic ammonia, for there are still large requirements in respect of nitrates (Germany produces upwards of £1,500,000 of nitric acid annually from Chili saltpetre) which have to be satisfied from foreign sources. They hope, however, to fill this gap in the home production of combined nitrogen by utilizing a reaction discovered by Kuhlmann as long ago as 1839, in which ammonia and air burn to nitric acid in the presence of platinum as a catalytic agent.

EXPLOSIVES.

I have already mentioned the importance of nitrates and of nitric acid, and have referred to the employment of the greater part in agriculture. Of the remainder, the major part goes in the manufacture of explosives and in the coal-tar colour industry.

The disruptive properties of gun-cotton are greatly moderated by gelatinizing by means of solvents (acetone, acetic ester, alcohol, and ether, &c.), and by mixing with nitroglycerin ballistic materials like cordite, and other smokeless powders are obtained. There is still another class of explosives which combine great safety in handling with enormous disruptive effect—picric acid, discovered by Woulfe, of London, in 1771, but first used by the French under the name of "Melinite" for filling shells in 1881, and later by the English under the name of "Lyddite." More recently this has been replaced by trinitrotoluene, first proposed by Haeussermann in 1891 for filling shells, and used by our Service under the mark "T.N.T." It is even less sensitive to shock than picric acid. "Ammonal," used by the Austrians for shell-filling, is a mixture of T.N.T. with ammonium nitrate, charcoal, and aluminium powder. It is both very safe and very powerful. T.N.T. is much used for demolishing bridges. It is so insensitive to shock that it is not exploded on being struck by a rifle bullet; and when in a shell it withstands the impact of the latter piercing an armour plate. Tetra-nitro aniline, obtained by Flürscheim, enjoys the unique position among explosives of having been discovered in this country. It is said to be as safe as, and even more powerful than, trinitrotoluene.

The manufacture of explosives in Germany is very highly developed. The total production of 40,000,000 kilos. includes dynamite explosives, 10,000,000 kilos.; ammonium nitrate explosives, 16,000,000 kilos.; and black powder, &c., 14,000,000 kilos. The world's production of explosives is now about 400,000,000 kilos. or ten times the German total output. We have at Ardeer, in Scotland, the largest explosives factory (Nobel's) in the world, covering 850 acres, employing 1800 men and 700 women, and producing annually about 16,000 tons of all kinds of high explosives.

INDUSTRIES DEPENDENT ON SYNTHETIC ORGANIC CHEMISTRY.

It is out of the profound study of synthetic organic chemistry which has been made during the past sixty years that the industries of artificial dyes, drugs, and perfumes have incidentally arisen. The earlier and pioneering achievements in synthetic organic chemistry are well distributed among European nations; but during the major part of the sixty years the great bulk of the discoveries in this domain have been made in Germany.

It is in respect of the works research laboratory that there is the greatest contrast between the chemical industries of Germany and those of other countries; and it is not surprising, therefore, that the present war should have served to emphasize the class of chemical products for which we are almost entirely dependent on that country. It is precisely those products—artificial dye-stuffs, artificial drugs, and artificial perfumes, which are the outcome of the works research laboratories—that are now in many cases unobtainable in consequence of the cutting-off of all the German sources.

The seriousness of the situation is apparent from the following figures, relating to dye-stuffs alone: The value of dye-stuffs consumed in England annually is £2,000,000, and the value of trade in which these dye-stuffs are employed is £200,000,000; while upwards of 1½ million workmen are dependent upon these industries. The total value of dye-stuffs imported into the United Kingdom in 1913 was £1,892,055, of which Germany contributed £1,730,821.

Alizarin (the essential principle of the madder root) was first synthesized by Graebe and Liebermann in 1869. At the time of this discovery, the world's production of madder was 50,000,000 kilos. of roots (1 to 1½ per cent. alizarin), representing 500,000 to 750,000 kilos. of alizarin, valued at £2,250,000. In 1870 France had 20,000 hectares (50,000 acres) under madder cultivation, which soon disappeared after the introduction of the artificial product.

The production of artificial alizarin was: 1873, 100,000 kilos.; 1877, 750,000 kilos.; 1884, 1,350,000 kilos.; 1900, 2,000,000 kilos. (four-fifths of this was produced in Germany). A great number of most valuable artificial dyestuffs, more or less closely related to alizarin, but not occurring in Nature, have been prepared by chemists, and the total value of the alizarin colour exports of Germany at the present time is about £1,000,000.

The Colour Industry.

The German colour manufacturers are organized into two principal groups or trusts: (1) the Badische Company, of Ludwigshafen; the Bayer Company, of Elberfeld; and the Berlin Aniline Company. (2) the Cassella Company, of Frankfurt; Meister, Lucius, and Brüning, of Höchst. The share capital of the two groups in 1911 was £8,000,000, paying a dividend of 25·8 per cent., and is probably now about £12,000,000, paying a dividend of 28 per cent. In 1860-70, Germany imported about £2,500,000 worth of dyes per annum; while in 1912 they exported about £10,000,000 and produced about £12,500,000 worth of dyes.

The composition of the *personnel* who carry on these German colour works is at the bottom of their success. Take the works of Messrs. Meister, Lucius, and Brüning as an example. In 1913 the composition was as follows: Workmen, 7680; managers, 374; expert chemists, 307; technologists, 74; commercial staff, 611. Contrast with the above the fact that the six English factories now producing dye-stuffs employ altogether only 35 chemists; while evidence of their relative activities is again furnished by the circumstance that between 1886 and 1900 the English firms took out only 86 patents, whereas the six principal German firms were responsible for 948 during the same period. Having shown that these German coal-tar colour manufacturers are without rivals from the commercial point of view, I feel it my duty to point out also that their industry is carried on under conditions of labour which are highly creditable to the management.

This vast and highly organized industry of dye-stuffs and fine chemicals, which is certainly one of the most outstanding manifestations of the modern German spirit, was formerly very dependent on England for its chief raw material, coal tar; and it is interesting to see how effectually Germany has emancipated herself from a control which might at any time become irksome or even paralyzing. The following figures show the production of coal tar in Germany:

Year.	Coke-Ovens. Tons.	Gas Manufacture. Tons.
1897	52,000 ..	—
1900	93,000 ..	—
1904	277,000 ..	225,000
1908	632,400 ..	300,000

In 1908, 40,000 tons were still imported from England, and in 1909, 18,000 tons; but 35,000 tons were also exported.

In 1900, the German production of coal tar was only about one-half of that produced in England; while by 1912 it had equalled, if not surpassed, the English production. Again, in 1880, Germany used 1400 tons of pure anthracene, of which only 200 tons was of German origin; while at the present time the 5000 tons now employed in Germany is all produced there.

The phenomenal increase in the German production of coal tar has depended upon a similarly rapid development of the German iron and steel industry, which has entailed an enormous demand for metallurgical coke, in the production of which the greatest attention has been devoted by Germany to the recovery of the bye-products—tar, gas, ammonia, &c. In England, the quantity of coal tar treated was 175,000 tons in 1870, and 640,000 tons in 1880. At present more than 750,000 tons are treated.

Conclusions.

The facts which I have brought forward speak for themselves, and proclaim in the most convincing manner the stupendous progress which has been made by Germany in the chemical industries during the past forty years. It is equally certain that England, once pre-eminent for chemical manufactures, has not progressed at the same rate, and is at the present moment suffering much inconvenience through being so largely dependent upon German chemical products of one kind and another. The country is now reaping the harvest of humiliation which it has sown for itself, in spite of the warnings repeated *ad nauseam* by the chemical profession during a whole generation. The whole of our arrangements have been evolved during the past half-century on the assumption that this country would never again be engaged in a European war; while still more recently the new democracy has vainly boasted that it could prevent such a war by means of a general strike. The year 1914 has seen the dissolution of many Fool's Paradises, and has given *coup de grace* to all these vain imaginings, with the result that we find our vast textile industry in serious peril because the much smaller dye-stuff industry has been complacently allowed to slide into the hands of our sagacious and more painstaking enemies. The same carelessness and want of foresight had even allowed us to become dependent upon Germany for some of the most important materials used as explosives—*e.g.*, trinitrotoluene—and for many of the most valued drugs required alike by our Army, Navy, and civil population.

The complete breakdown in our supply of fine chemicals, which is the direct outcome of the disregard of the constant warnings emitted by scores of British chemists, has led the Government of the day to intervene, and attempt to remedy the intolerable state of affairs which has arisen in connection with the supply of coal-tar colours. We devoutly hope that success will attend the endeavour to establish the coal-tar colour industry in these islands on the largest possible scale. Whatever the ultimate scheme adopted may be, I would point out that it must be based on a clear understanding of the following considerations:

1.—That the provision of the required chemicals during the continuance of the war is one thing, and that their production on a commercial basis after the cessation of hostilities is quite another matter.

2.—It appears to me that in order to provide the needful supply during the war, the only reasonable course is to assist in every possible way those firms which are already making similar or closely allied products, so as to enable them to produce their present goods on a larger scale, and, as far as practicable, to undertake the manufacture of others which are urgently required. The immediate problem will be also greatly facilitated by utilizing supplies obtainable from neutral Powers, and more especially from Switzerland, which is the only country, other than Germany, in which the manufacture of dye-stuffs and similar chemical products has been vigorously prosecuted.

3.—As regards the prospect of the home industry after the war, it will require "nursing" for a much longer period than has hitherto been mentioned. In this connection, I would point out that the sum of £10,000 a year for ten years, as a guarantee for research purposes, is absurdly inadequate.

4.—If the industry is to prosper, it will not only have to manufacture materials already known, but also continually to be introducing new products of its own discovery, as well as constantly to be seeking to produce more economically a great number of auxiliary chemicals required in the manufacturing processes. It is also essential that the undertaking should branch out into the manufacture of other materials as occasion may arise for advantageously utilizing bye-products.

5.—The competition which the industry will have to suffer from Germany is likely to be much more serious than is generally supposed, because it must be remembered that England only takes about one-fifth of the total German exports of dye-stuffs; so that it would be comparatively easy for German firms specially to reduce the price of goods sent to England. They have already done this in America when attempts have been made to start an aniline industry there. It is particularly significant, and augurs ill for the prospects of this scheme to rehabilitate the coal-tar colour industry, that the latter has failed to flourish anywhere excepting on German soil, and that countries with fiscal systems entirely different from our own have been no more successful in this respect than we have ourselves.

6.—It will certainly be necessary that expert chemical knowledge should in the future be much more highly remunerated than it has been in the past; otherwise the supply of able and properly qualified men will not be forthcoming. Notwithstanding the absence of material inducements, I venture to say without fear of contradiction that there is more original investigation being prosecuted in this country by chemists than by any other body of British men of science; and this I attribute to the fact that such a large proportion of our number have either been at German Universities or are the pupils of those who have been at these centres of research.

7.—If the proposed undertaking is to succeed, real chemists must be on the directorate, and in a sufficient proportion to give effect to their views. Many men of science are excellent business men. What does experience teach in the case of flourishing chemical industries which we fortunately still have among us?

8.—In attempting to establish a commercially successful coal-tar colour company on a large scale in this country, I venture to think the Government have undertaken a task which they will find to be surrounded with difficulties of quite a different order from those which they have had to encounter in some of their most striking previous legislative acts, such as the provision of salaries for members of Parliament, the granting of old age pensions, and the establishment of a compulsory system of insurance. These are matters in which, if the Government dictate, we are obliged to obey; but the commercial success of an industry which is based upon progressive scientific investigation depends upon factors so subtle and elusive that they cannot be coerced, even by a majority of the House of Commons.

9.—If the chemical industries are to be rehabilitated in this country, there must be a complete change in the attitude of mind towards science in general, and towards chemical science in particular, among the influential classes of the population; and it will certainly not be effected by following the precept "Business as Usual," but by pursuing a policy which is the exact opposite of what is implied by that vulgar and undignified phrase.

Under the auspices of the Leeds Section of the Institution of Electrical Engineers, a lecture was delivered at the Bradford Technical College last week on "Good Lighting and its Immediate Effects from the Economic Standpoint." Mr. V. H. Mackinney should have delivered the lecture, but his place was taken by Mr. Stroud. The lecturer said that good lighting was important from various points of view. Bad lighting affected the health deleteriously, and it was found that much the larger proportion of accidents happened in the winter and during twilight hours. A great deal of work was done in artificial light, and it was important to bear in mind that a small increase in output would more than repay the enhanced cost of improved lighting.

ESSENTIALS OF MODERN GAS COMPOSITION.

By William Cranfield.

[Annual Lecture to the Scottish Junior Gas Association (Western District), Delivered April 17.]

The trend of modern industrial methods is towards standardization, and probably not a few members of the general public imagine that, if a given illuminating or calorific standard were maintained in town gas, standardization and uniformity would be achieved. But even if the supply of (say) 16-candle gas, or 500 B.Th.U., could be enforced on all gas undertakings, the gas would still exhibit wide differences.

The same gas everywhere is palpably impossible with all the multitudinous possibilities of difference in carbonizing conditions, condensing, purifying, and enriching methods, to say nothing of differences in coal. Even on the same plant, the gas being made varies almost minute by minute. In some cases the unfortunate manager has to feed into and from the same holder, and that with inlet and outlet pipes in proximity. This means that at times the gas goes practically direct from one to the other, and the varying quality of the make is at once felt by the consumers. Even if we could standardize our plant and methods, the working conditions would be almost ceaselessly varying. No plant is ever monotonously perfect in its working; and even if this consummation could be attained, the human element would still persist in its variations, and no gas-making method can entirely dissociate itself from this source of uncertainty. Every one of these considerations means a variation in the composition of the gas.

As the dream of absolute and universal uniformity is likely ever to be unrealizable, we must content ourselves with approximations to fixity of standard. The great questions then face us: What shall this standard be? What are the things that really count in gas? Thirty years ago the answer would have been simple. It would have been given promptly by anyone, and in practically the same terms. It would have been:

1.—The complete removal of ammonia and sulphuretted hydrogen.

2.—Illuminating power of so many candles.

In many cases there would have been added

3.—A practically complete removal of carbon dioxide.

4.—A reasonably low amount of sulphur compounds other than sulphuretted hydrogen—say, below 25 grains of sulphur per 100 cubic feet.

Purity.

Freedom from ammonia and sulphuretted hydrogen need not detain us. What about the other sulphur compounds? When Parliament consented to the abrogation of the sulphur clauses under which the London and some Provincial gas undertakings worked, it was hoped, and commonly asserted at the time, that the discontinuance of the special sulphur purification (intricate and costly as it was) would not, as a rule, mean that more than from 30 to 35 grains of sulphur per 100 cubic feet would be found in any town gas. Unfortunately this hopeful expectation has not been so far realized, and some towns have returned to special means of purification.

Just at present we are discussing ideals rather than methods. Ought we to be content with existing results, or ought we to aim at a sulphur-free gas? Sulphur in gas is one of the weak points in our panoply. Too few engineers know the exact sulphur content of their gas, and probably some shrink from facing the unwelcome truth. Certain it is, that cases have been known where not only the old maximum, but even the more generous amounts supposed to be present were greatly exceeded.

It may be admitted at once that the small amount of sulphur dioxide produced from one or two incandescent burners in a room is negligible, and that the classic research of Dr. S. Rideal and Mr. Otto Hehner showed how strikingly whitewash and plaster act in absorbing the sulphur dioxide so formed. Still the great discomfort of any sulphurous fumes—especially to anyone with an asthmatic tendency—ought to stimulate our endeavours after a really clean gas. The question assumes a more serious aspect when all the top rings, &c., of a cooker are in use for some time in a small scullery. I once went into this question chemically and mathematically in my own case, and so speak feelingly and think strongly. The same trouble arises in cases when a flueless heater has been installed in a bedroom or office where there is meagre ventilation. I remember once visiting a well-known engineering establishment, and finding the officials thirsting for the blood of the traveller who had induced them to instal six or seven gas-heated radiators. Short of putting in a hot-water circulation (which they had declined to do), radiators such as those actually in use were the only available things. The atmosphere of the offices on a cold mid-winter day, when no windows were open, was highly sulphurous, as was the language also. What was wrong was not the radiators, but the gas, which was quite abnormally rich in sulphur.

Ventilation nullifies most of this disadvantage of the sulphur in gas; but there remains the other great drawback of its corrosive action on burners and fittings, on water-heaters, &c. Electricity has such an advantage on this score that, in sheer self-defence, we ought not too easily to rest satisfied with the existing situation, or too readily to admit its inevitableness.

Illuminating Power.

Almost every statutory gas undertaking is still under legal obligation to supply gas of a certain candle power. Now that incandescent burners are used for nearly all gas lighting, this standard is obsolete and almost meaningless. Insistence on it is apt to be a bar to progress and a hindrance to economy, without being any real protection to the consumer. It served some useful purpose in its day, in securing a fairly uniform quality of gas; but that day is past. Candle power of gas is but a conventional term at best, depending on many minutiæ and corrections in testing, and upon the use of a specially favourable burner not in common use. It was always misleading in what it encouraged a consumer to expect from his own burners.

Calorific Value.

So far we have been considering the gas requirements of the past. The great demand made on modern gas is that its calorific value should be satisfactory. This is the inevitable standard by which to judge gas now that practically every instance of its use is dependent on its heating power. The meaning is easy for a layman to grasp. The standard is neither a fictitious nor a conventional one, but a real criterion of value. The test is easy to perform within practical limits of accuracy, and can be made continuous and self-recording.

Simple as is the test, scrupulous care should be exercised in its execution, and in keeping the instruments up to concert pitch. Arrays of numerical results are not always impressive, unless something is known of the attainments, methods, and appliances of those responsible for them. A sense of proportion is akin to a sense of humour, and would be an invaluable asset to some people who (for example) vehemently discuss a few extra feet of gas per ton of coal, or an extra 5 B.Th.U. in the gas. It is well to face facts frankly, and not to carry out calculations to a degree of minuteness inconsistent with the limits either of the apparatus or of the investigator.

It is so easy to get unduly favourable tests on the works that it would be well occasionally to check them by taking tests for calorific value (or candle power) out in the district. I once found a case where the candle power was tested on a short service taken off immediately after benzol enrichment, when the gas would still be laden with liquid particles of condensing hydrocarbons. I have, on taking independent tests of calorific value out on a district, obtained results 20 per cent. below what was claimed to be maintained at the works. What gas is, in quality, pressure, &c., at the point of consumption is what counts.

As to what figure should be fixed as a proper calorific standard, I do not propose to say much at this point. Englishmen dearly love compromise, and favour the safe average course. Something between 500 and 550 B.Th.U. is becoming a common agreement. For reasons I shall touch on after, I consider this is too high—unnecessarily too high. Much, of course, depends on the price charged for the gas, but a lower grade gas can not only be made more economically, but is also more economical in use. A 750 B.Th.U. gas would not in practice be 50 per cent. better than a 500 B.Th.U. gas. It might possibly even give in many uses a lower efficiency. Lower-grade gas is actually being used, and the results—especially the lighting results—are a surprise to some who are only accustomed to the higher grades. The proposition is sound in theory and substantiated in practice.

Extra Requirements.

We have now discussed the usual present-day requirements of gas—viz., purity and calorific value. As far as legal requirements are concerned, these are probably enough; but for those who are keen on realizing the utmost efficiency from their commodity, other and all-important considerations loom ahead, on which the gaze must be fixedly kept. Legal obligations cannot very well be attached to some of them, but they have potent moral claims on us. In fact, my original intention was to entitle my lecture "The Morality of Gas Composition." Foremost among all these extra requirements, I would place

Constancy.

A rigid and absolute constancy in some respects is impossible, but we may cherish it as an ideal to be approximated. The brilliant and erratic genius may be a valuable asset to his own and later times, but the steady plodder of uniform accomplishment and reliability is the backbone of a nation's strength. In the case of gas, it is emphatically true that a lower grade of quality (in any sense) is better than great irregularities, however high the occasional peaks may soar. I need not elaborate the advantages of a constancy of calorific value, and you will probably accord at least a theoretical assent to a plea for constancy.

Pressure.

Though not strictly included under my title of "Gas Composition," pressure comes well within the purview of an inquiry as to what a standard gas shall be. The change from the flat-flame days, with their necessary maxim of keeping down the pressure, to the present-day conditions, when the efficiency of gas appliances, especially in the case of lighting, depends so largely on an adequate constant pressure, is such a radical change that accomplishment still lingers behind belief, and belief is more a formal assent than a vitalizing conviction. Naturally gas undertakings have no desire for additional statutory obligations and penalties. The existing condition of mains, too, is not always favourable to

the realization of one's desires for higher pressures. Still I hope we are agreed as to the necessity of 3 inches pressure at the consumer's meter. Anything much short of this is unworthy of the name of pressure. It is, of course, the pressure at each consumer's meter, and even at his separate points of consumption, that we have to assure ourselves about, and not merely what it is at the outlet of the station governor.

Seeing that pressure is an absolutely vital essential to the satisfactory working of gas appliances, in order that they may inject the amount of primary air most suitable for high efficiency, it is obvious that it is not only adequate pressure that is called for, but, as nearly as can be secured, a constant pressure at all times.

Density.

We have now reached the requirements of purity, adequate and constant calorific value, and adequate and constant pressure. As a check on quality, a test of density has been suggested; and this is actually carried out on some works. Of all suggested checks I regard this as the most mischievous, because the most unreliable and misleading. It appeals to a desire for an easy, automatic, and self-recording test. If perfectly uniform conditions of working could be ensured and maintained, a fall in the density of the gas might reasonably suggest, if not directly evidence, a fall in value. There is, however, much virtue in the "if." The apparatus is necessarily delicate, a disarrangement might easily remain unnoticed, and the conclusions drawn from its readings might be more than usually misleading. The use of a density test is surely to be deprecated on a works where the attendant can hardly, by any excess of flattery, be termed an expert; and what I have actually known on works of no inconsiderable size, and with apparatus of a more robust type, does not inspire me with much confidence in the test as an integral part of gas-works routine.

The fatal defect is, however, inherent and not dependent on shortcomings in apparatus or operator. An increase of the undesirable incombustible constituents—carbon dioxide and nitrogen—will put up the density, as also will an increase of valuable hydrocarbons. An increased amount of indrawn furnace gases may thus mask a shortage of hydrocarbons, and may even seem to denote an enhanced value because an enhanced density. Most extravagant claims have been made for this test, and the security it may afford an engineer. But it does matter greatly what is supplied as gas, even if the density does not vary; and the consumer will soon find it out. Let us suppose the oil in the water-gas plant is not being economically used and "cracked" at the right temperature, or that for some other reason the percentage of illuminants in the gas is lessened, then the density will go down. This will be seen at once from the following densities: Air 14½, coal gas about 7, ethylene 14, benzene vapour 39, &c.—all the illuminants having densities of 13 and upwards. Let the engineer now increase his exhauster pull, and draw in furnace gases through leaky retorts. As these will be mainly nitrogen and carbon dioxide, with densities of 14 and 22 respectively, the density of the finished gas will go up; and if only enough is drawn in, the increased density will, in the words of one enthusiast, secure that the engineer "should not have many troubles." Or he will perhaps lengthen the run of his water-gas generator, and increase the amount of carbon dioxide in his gas. Again a drop in density is corrected, and all should be well. Or more air may be admitted along with the gas into the purifiers. This will also bring up the density, and presumably correct the fall in the illuminants.

The point needs no further elaboration, as the absurdity of the whole situation is evident when we consider that the substitution of incombustible nitrogen for the very valuable illuminant, ethylene, would leave the density unchanged, and so would other exchanges of varying amounts of worthless, or nearly worthless, gases for rich illuminants. And with it all, some advocates would bid us rest easy; the consumer should be satisfied, and the engineer not have many troubles.

Incombustible Constituents.

This leads to the further consideration of the incombustible constituents of coal gas—viz., nitrogen and carbon dioxide. Now that lime purification is so largely discontinued, only that portion of the carbon dioxide is removed which is absorbed in the liquor, and some 1½ to 3 per cent. may remain. The presence of some nitrogen is inevitable; probably an amount equal to about 1 per cent. of the total gas being derived from the coal itself. Anything beyond this limit has come from the air, either directly or indirectly, by way of indrawn furnace gases. With the modern desire for high makes, and with the race for favourable positions in the scale of comparative yields, this question has assumed an importance which, it is to be feared, is not adequately realized. The nitrogen contents of coal gas have commonly been merely assumed, and assumed at a very low figure. The difficulties of the older methods of gas analysis, in which it was found by difference, was almost a sufficient excuse for this. With the advent of convenient apparatus for its direct estimation by combustion over copper oxide, it will be well if this test of town gas is carried out with a frequency and universality worthy of the importance of the information it affords. For some years past I have been closely watching this question, and have discussed it freely. In many cases I find a reluctance to face the facts, or at least a strong incredulity as to what I asserted. The idea of an important gas-works sending out gas with from 12 to 16 per cent. of nitrogen was startling when other impurities are measured in grains per 100 cubic feet. When still larger proportions of incombustibles were vouched for, I have even been asked if such a gas would really burn—surely a rather futile question when one remembers the amount of incombustible constituents in producer gas and suction gas.

When I was first asked to give this address, I chose the subject of nitrogen in gas, and planned a series of independent investigations on the nitrogen content of town gas as actually being delivered to consumers in a considerable number of towns up and down the country. I have been prevented from carrying out my intentions, and so will confine myself to general statements and a few quoted examples.

This evil of an excessive proportion of incombustibles is much more general and more serious than is commonly realized. It arises chiefly from unsound retorts combined with a pull on the retorts, and is, of course, emphasized by over-exhaustion. The figures recently given by Mr. J. G. Newbigging in this connection are very striking, and I commend them to your consideration.

Samples o Gas Taken from the Foul Main at the Inlet to the Retort-House Governor.

	Carbonic Acid.	Nitrogen by Difference.	Total Non-Combustibles.	Calorific Value in B.Th.U. per Cub. Ft.	
1	3·50	4·77	8 27	677 1	Gauge showing 1-10th pressure
2	3·50	9·43	12·93	644 6	
3	3·40	8·61	12·01	620·0	
4	3·40	8·90	12·30	599 5	
5	3·60	9·28	12 88	584·5	
6	3·50	7·92	11·42	580·2	
1	4·70	16·72	21·42	513·9	Gauge level.
2	4·20	20·45	24·65	471·5	
3	5·00	21·56	26·56	471·5	
4	5·30	20·91	26·21	453·7	
5	5·30	23·80	29 10	443·6	
6	5·30	25·02	30·32	439·0	
1	4·20	33·63	37·83	385 9	Gauge showing 1-10th vacuum.
2	4·40	25·07	29·47	466 3	
3	4·80	29·29	34 09	420·1	
4	4·90	30·61	35·51	399·0	
5	5·20	33·58	38·78	372·9	
6	5·30	34·22	39·52	356 1	

The retorts from which the above samples were taken are horizontals worked with a dry main; the main being sealed during the time occupied by drawing and charging. The first sample was taken immediately after closing the last mouthpiece lid after charging; the remainder at intervals of about 25 minutes—the last sample being taken just prior to sealing the main in readiness for the next charge.

Remembering what size of fissures can sometimes be found in retorts, these tables are eloquent in their suggestiveness as to how gas may be degraded by such over-exhaustion as might be called excessive. I have known cases of an amount of pull on the retorts that I should not have credited had not the responsible managers themselves told me of them. The device of drawing in producer gas through a pipe has actually been used in order "to make gas."

Lest I should be thought to exaggerate the amount of incombustibles actually in gas, let me name two other recent utterances. Mr. Newbigging only quoted experimental working, and it is not suggested that Manchester is supplied with abnormally nitrogen-loaded gas. Mr. W. Buckley, the Chemist of the Manchester Gas Department, in a recent address to the Manchester District Junior Association, spoke of analyzing the gas supplied in another district, and finding that the non-combustibles varied from 17¾ to 20 per cent. Mr. W. B. Leech, in his recent report to the Leeds City Council, spoke of no less than 39 per cent. of nitrogen in the gas sent out from one of the Leeds works, whose carbonizing plant he intends to replace by a more up-to-date and efficient installation.

In this connection it is well to remember the perils lurking in the oscillation of the liquid in a hydraulic main. To think and speak of the depth to which the dip-pipe penetrates below the level of the liquid, and to forget that the hydraulic main gas pressure, or pull, has to be borne in mind in reckoning the actual gauge reading on the retort, is bad enough; to ignore the violent alternations of pressure and pull when waves 6 inches from crest to trough can be seen in hydraulic mains, is much worse. With a normally level gauge on the retort, this might mean variations from 3 inches pressure to 3 inches pull. The advantages of a dry main will become more commonly investigated the more the effects of this oscillation of liquor is borne in mind. Retort-house governors are powerless to deal with this, and may lead to a false sense of security. Dry mains will yet come to their own, and probably also those arrangements which combine the advantages of dry and wet mains, and which can readily be converted from one to the other at will. In passing, again let me urge you to face the facts frankly, to investigate and find your actual retort gas pressure. I remember a friend and former student taking this advice, and following a suggestion of mine which revealed to him the fact that a retort that was thought to have a ½-inch seal actually showed 7 inches back-pressure.

Flame Temperature.

Calorific value is not in itself the main essential of a gas used for modern lighting; and, in varying degrees, the following

remarks hold good of some of the other uses of coal gas. For lighting, the prime essential is flame temperature. This cannot, however, be elevated to the dignity of an official standard, but the steady keeping of our attention on this matter may lead us to recast some of our opinions about what kind of gas we should supply.

Flame temperature depends mainly on four factors: The calorific value of the gas; the extent to which the gas is diluted with incombustible constituents; the air-gas ratio; and the proportion of the total air necessary for complete combustion that is injected as primary air.

The expression "air-gas ratio" is commonly used to indicate the ratio between the volume of the gas and the volume of air necessary for its complete combustion. This is one of the vital points—the most vital one, I think—in connection with modern gas. Most coal gas needs from 5 to 5½ times its own volume of air for complete combustion. Some accurate, speedy, and fairly easy method of arriving at the figure experimentally is much to be desired. So far, the best suggestion is that made by M. André Grebel at the annual meeting of the Société Technique de l'Industrie du Gaz en France in 1912. He not only described a test, but suggested a name that should express this air-hunger of burning gas—viz., comburivorous power. He recommended that this should supplement calorific value as a standard for gas, the two together giving a measure of the thermic value of the gas. The "thermic value" of a gas is the number of B.Th.U. in a cubic foot of a self-combustible mixture of gas and its proper proportion of air (measured at standard temperature and pressure).

Comburivorous power is the volume of air needed to burn one volume of the gas. So that

$$\text{Thermic power} = \frac{\text{Calorific value}}{\text{1 volume of gas} \times \text{its necessary volumes of air}}$$

or

$$\frac{\text{Calorific value}}{\text{Comburivorous power.}}$$

The calorific value of a gas being a definite and fixed quantity, the longer the flame with which a certain amount of gas burns, the lower the flame temperature attained. Under a given set of constant conditions—such as the same pressure, rate of burning, type of burner, relative proportion of primary air, &c.—the greater the air-gas ratio, the longer the flame and the lower the flame temperature. Consequently, it is not only possible, but it frequently happens that a gas of comparatively low calorific valve but a low air-gas ratio gives a higher flame temperature than a gas of higher calorific value which needs more air for its combustion. For example, blue water gas with a calorific value of about 300 B.Th.U. has a higher flame temperature than many specimens of coal gas of about 500 B.Th.U. The great value of blue water gas for welding and for some other metallurgical processes depends on this very fact.

Here is to be found the great justification for lower grade gas; and its advocates have solid ground on which to build-up their arguments. Hydrocarbons need a comparatively large volume of air for their complete combustion—*e.g.*, acetylene needs 12½ times its own volume of air, ethylene 15 times, propylene 22½ times, benzene 37½ times, &c., while hydrogen and methane need only 2½ times. The hydrocarbons (other than methane) are the illuminants in gas, and a comparatively rich gas may do very well for flat-flames, but is a positive drawback to many modern uses. A suitable low-grade gas is likely to have a higher flame temperature, its lower calorific value is utilized to better advantage, and its lighting efficiency with incandescent mantles, and especially with inverted ones, is very striking. While some folk, wedded to old customs, and some who would fain pose as custodians of the public interests, clamour for a return to the old quality of gas, in other parts of the country more fortunate consumers are getting a very good light indeed from so-called poor gas. While quibbling over half-candles is going on in some places, in others bold spirits, favoured in their opportunities, are showing with a splendid amount of success that low-grade gas is *the* gas for lighting purposes.

For many heating purposes the same holds good to a large extent. In how many towns are the unmanageably long flames of the boiling-rings on cookers seen lapping far up the sides of the utensils? Much heat is certainly then being wasted; and the unpleasant effects of broken inner cones of the flames ensue. A short keen flame renders better service, and a lower grade would give the greater efficiency. The use of these long flames for such purposes is closely analogous to the use of rich bituminous coal instead of steam coal under boilers.

Here, too, is seen the disadvantage of the presence of a high proportion of incombustibles in gas. Not only is it a degradation and adulteration of the gas, on a par with selling coke with 22 per cent. of moisture in it (as I once found a customer complaining about), but in uselessly swelling the bulk of the gas, it is reducing its possible flame temperature.

Making a Lower-Grade Gas.

Dealing as I am with principles rather than with methods of their application, I am not venturing to treat of the question that you are probably mentally putting, How are we to make this low-grade gas? In passing, I will, however, commend to your study the address recently given by Professor Vivian B. Lewes to the London and Southern District Junior Gas Association. In it he pleads, with the happy knack of phrase-turning that he has, for diluting instead of degrading the gas, and for a better utilizing of the coke by gasifying some of it. The addition to our gas of some blue water gas would at once give a lower-grade gas with a very effective flame temperature because of its lower air needs. The Dessau system of intermittent vertical retorts, with its practice of steaming the exhausted red-hot charge, is a reasonable and valid way of securing high yields of real gas. There are also other ways of using blue water gas as an accessory to coal-gas manufacture in such a way as to utilize some of the hydrocarbons that the straight coal gas cannot retain. I know such processes (with which Professor Lewes's name is coupled) have been regarded somewhat coldly; but the last word on the subject may not yet have been spoken.

Constancy of Air-Gas Ratio.

In the last place let me again speak of what is probably the chief essential in modern gas composition—viz., some approximation to constancy of composition. I have referred to the impossibility of securing this as between different towns, and the difficulty of securing it even on any one works. I appreciate the inevitable variations in the make, but I do deprecate the avoidable variations that originate from occasional enrichment, from variation of exhauster pull, from the occasional addition of carburetted water gas, from variations in the carburetting of that water gas, and variations in the amount of added water gas.

Of complaints from consumers, other than those arising from naphthalene and defects in appliances, nearly all arise from inconstancy of either gas composition or gas pressure. We assert that one of the chief advantages of coal gas over electricity, suction gas, &c., is its reliability—that it is always ready, and always the same. To live-up to such claims, as well as in self-interest, we must aim at making constancy an attribute of the gas we supply. This is even more important than the question of the amount of its incombustibles. Even with a comparatively poor and only moderately satisfactory gas, burners, engines, &c., can be so adjusted as to give very fair results, so long as the conditions remain the same. But vary your gas, for better or for worse, and all your adjustments are at fault, efficiencies drop, and consumers suffer—not always patiently or in silence.

Practically, what is needed (as you will perceive) is not so much constant composition, or even constant calorific value, as an approximately constant air-gas ratio. If this is secured, adjustments are correct, even when the inevitable variations in chemical composition occur. It is not easy to ensure this constancy; but by uniform methods and conditions we may render it possible.

Summary.

I have not exhausted my subject. I have not even touched on naphthalene, or toluol, or the need of well-aërated flames; but I have exhausted the available time and your patience.

May I just recapitulate what I regard as being the essentials in modern gas composition.

1.—Purity from ammonia, from sulphuretted hydrogen, and (as far as possible) from sulphur compounds.
2.—Constant calorific value and a lower one than is commonly adopted.
3.—Adequate and constant pressure.
4.—Only a small proportion of incombustible constituents.
5.—High flame temperature, secured by a low air-gas ratio, low nitrogen content, no excess of hydrocarbons, and ample aëration of flame.
6.—Constancy of composition, or at least constancy of air-gas ratio.

Now in conclusion let me say that, however imperfectly I have risen to the height of such an occasion as your annual lecture, I have at least dealt with subjects of whose great importance I am assured. I have endeavoured to keep your faces turned to the light, and to the things that really count. Others will bespeak your interest (and rightly so) in engineering, in commercial, and in distribution problems, and will emphasize their importance. In discussing your prospects, friends will tell you that the future is for the man who sells gas, rather than with him who makes it. I see great possibilities, also, that beckon to the technical physicist and chemist. I believe that the laboratory and experimental plant will have their victories, no less renowned than those of the battlefield, the workshop, and the market-place. Realize, if you can, what the gas industry owes to a few of such workers as Bunsen, the professor in quiet little Heidelberg, whose burner is incorporated in practically all our gas-using appliances; Welsbach, the investigator of the rare metals such as are found in what Sir W. Crookes calls the world's dust heap, whose work has saved its lighting field for the gas industry; Perkin, the eighteen-year-old schoolboy, working in his home laboratory and giving an astonished world a glimpse of the wondrous possibilities of the coal-tar derivatives; and lastly Young and Beilby, who taught Scotland how best to utilize its oil-shale, and showed the way for continuous carbonization of coal in vertical retorts. What other work compares in importance with these in the past sixty years of the gas industry?

That industry is neither effete nor at the end of its possibilities. In some directions its great achievements may yet lie before it. There is room for the utilization of the best powers of the best of us, of all of us, and especially of the juniors. Gas says, in the historic words of the Edinburgh boy overwhelmed in a ruined house in the Canongate, "Heave awa', lads. I'm no deid yet!"

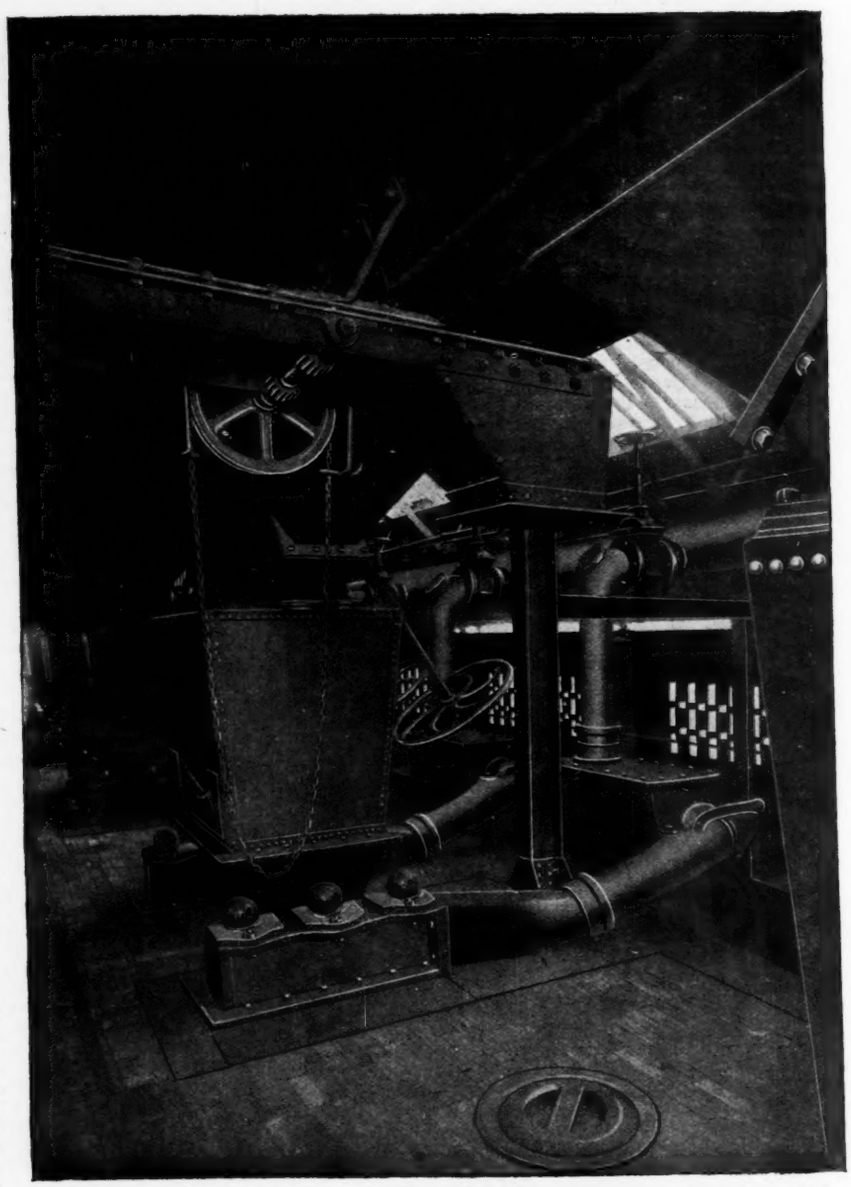
YORKSHIRE JUNIOR GAS ASSOCIATION.

Inspection of the Dempster-Toogood Vertical Retorts at Hebden Bridge.

The members of the Yorkshire Junior Gas Association last Saturday afternoon paid a visit to the Hebden Bridge Gas-Works, for the purpose of inspecting the Dempster-Toogood system of carbonization in vertical retorts, one installation (an illustrated description of which appeared in the "JOURNAL" for Oct. 7, 1913, p. 40) of which is in working there, and a second, with slight improvements, has recently been completed and is about to be put into operation.

A SHORT HISTORY OF THE HEBDEN BRIDGE UNDERTAKING.

Mr. J. SIMPSON, J.P., the Chairman of the Hebden Bridge and Mytholmroyd Gas Board, welcomed the visitors, and recounted a brief history of the gas undertaking, in which it was seen that unusual difficulties had had to be met, owing to the topographical situation and other reasons. The present Board, he said, had taken over the undertaking nearly 20 years ago, on a 27 years' lease, from the existing Gas Company, for the sum of £68,000. He was sorry to say the concern had been over-capitalized from the beginning. Like many other people who had things to sell, the Company obtained practically all they could out of the works before parting with them, and had almost worked them out. The Board had to renew practically the whole of the plant, and, he must admit, they could see now that they had made certain mistakes at the beginning which would not have been made if they had known all they had experienced since that time. When they took over the undertaking, the make of gas was 42 million cubic feet per annum; last year, it was 106 millions. The works had always been cramped and confined in a very small and awkward area of space; and at the commencement they realized that more land would eventually be required. For this reason, they purchased the building which was now the retort-house and other structures, with as much regard to convenience of working as was possible in the restricted limits. The new gasholder had had to be put quite away from the works. It had been hoped to rebuild the entire works on this land, and make a model works there; but there arose a strong feeling of public opposition to gas-works in the neighbourhood, and the idea had to be given up. After careful study and considerable anxiety, the difficulty of limited space was overcome by the decision to instal the Dempster-Toogood plant that the Association saw in 1913. The second installation was now completed, and would soon be working. Their Manager (Mr. Ernest J. Wellens) had had a very anxious time during the past few years, as the visitors would realize if they could fully understand the many and peculiar difficulties he had had to face. They had now every hope of a successful solution of their difficulties by the installation of the second bed on the Dempster-Toogood system.



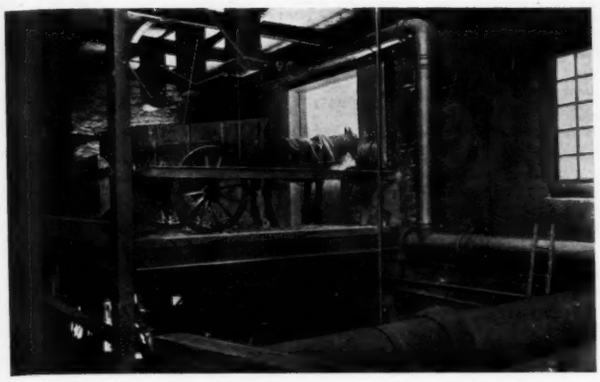
Individuality of Each Retort, showing the Gas Offtake, Self-Sealing Cleaning Lid, Hydraulic Main, Seal-Valve, Ascension-Pipe, Peet's Valve, and Liquor Supply.

THE WORKS PAST AND PRESENT.

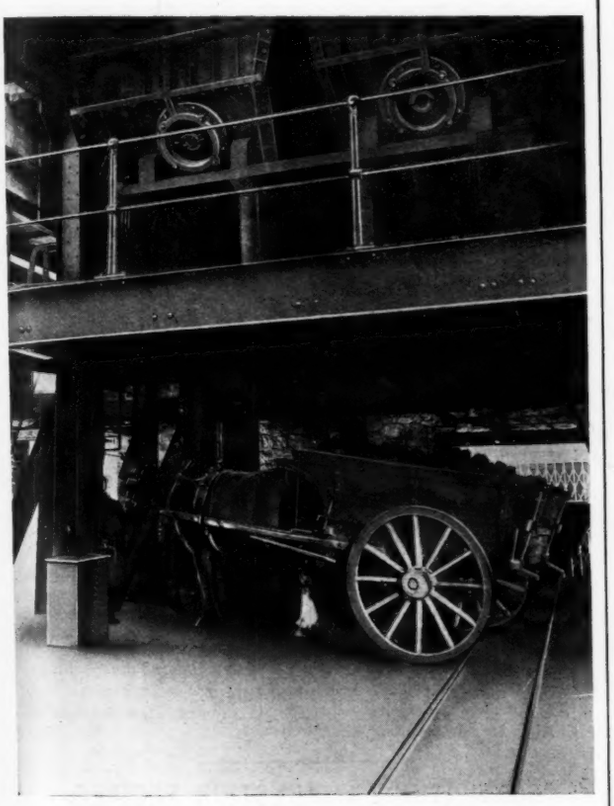
Mr. E. J. WELLENS, the Engineer of the works, said he was glad his Board had again invited the Association to visit the works. On the occasion of the previous visit, the members had seen how great difficulties had been partially overcome. In considering the removal of a works there were many issues to be considered. In view of these, they had had to bear in mind that the present site, with all its disadvantages, had the advantages of a high-level railway on one side and a high-level road on the other. These were considerations which helped them in the decision to stay where they were. The works were, of course, sandwiched in—like the town as a whole—between great hills. The railway imposed a further limitation. The works occupied a long triangle, bounded by the road, the railway, and a chemical-works which could not be purchased. The greatest width of the site was that of the retort-house, only 58 feet; and it was necessary that a way should be retained through the retort-house for all works traffic. The house had horizontal carbonizing plant along one half of its length; the remaining half containing the underground tar well, over which the only available floor space in the whole works was situated for the quenching, storing, and handling of coke. The adoption of the vertical carbonizing system had meant the abolition of the whole of the existing system. They had put in a quarter-of-a-million installation, which was now working, and a second installation of similar capacity, not yet working; and yet they had still the original coke storage of 200 tons.

THE TOUR OF INSPECTION.

Mr. Wellens and Mr. H. J. Toogood (of Messrs. Robert Dempster and Sons, Limited, the contractors) then conducted the party over the works. The visitors were shown how the installation of vertical had necessitated the loss of the existing tar well and coke yard. The tar was now stored in steel tanks over the elevated railway siding; and the vertical retorts so little impeded floor space that the flooring, of ferro-concrete, provided room for coke handling and storage by gravity, and carts could now be backed under the retorts and take the cooled coke direct. Carts could also back in from the high-level roadway on to the concrete roof of the engine-house, which forms a floor at a convenient height, also for the loading of railway waggons; shoots being provided in the floor for both purposes. The bulk of the coke as it was discharged into trucks was now taken up the elevator to the coke



Coke Loading by Gravity from the Overhead Coke Floors.



Unique Coke Handling Direct from Retort to Consumers' Carts.

compartment of the storage hoppers, from which it might be controlled and allowed to gravitate on to the coke floor, into the furnace, into retorts, or into the railway trucks or carts. At present the coal was handled by coke-trucks and the hoist; but eventually it was intended to instal a duplicate elevator, for which provision had been made.

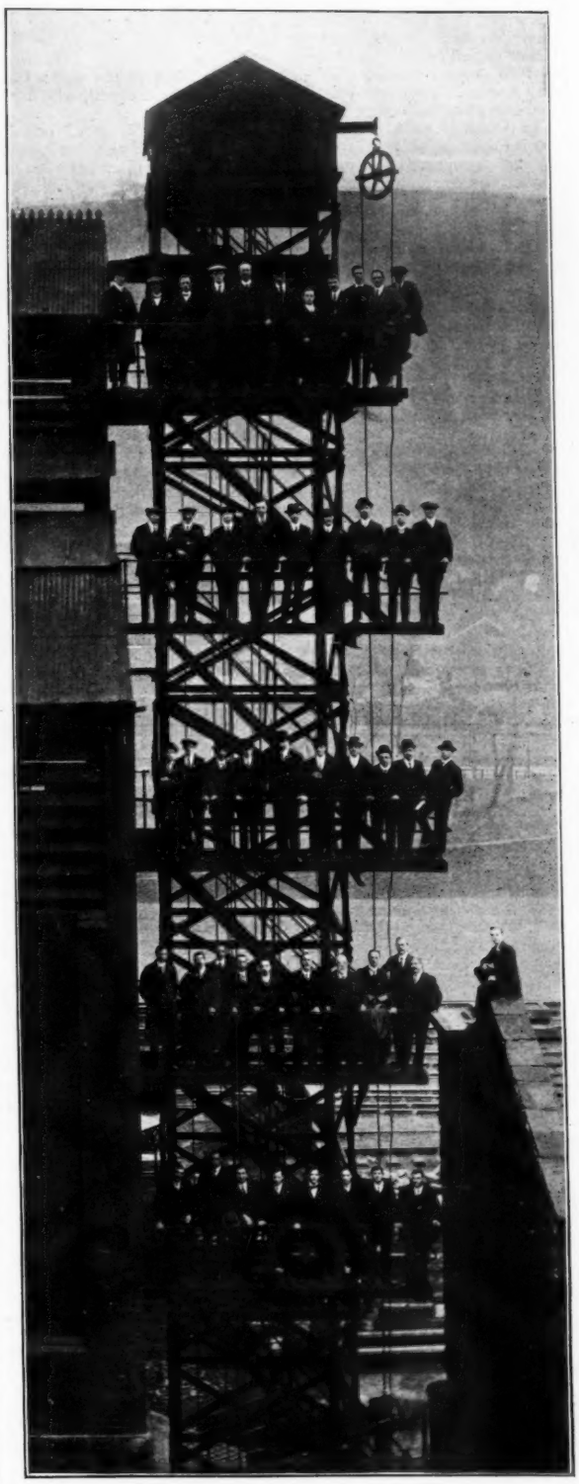
Attention was drawn to the coal-breaker, with twin receiving hoppers, automatic feed, and bye-pass screens, for mixing the coals, which was arranged under the elevated railway siding, but all of which was above ground, and would allow of the blending of nuts and screened coal. Over two retorts was a long twin coal and coke hopper; the retorts being readily fed by a couple of simple operations by the workman. One of the most notable improvements in the plant was the gas-tight coal and coke valve over the retort. The coal-filling chamber and shoot were thrown back to one side, instead of being centrally over the retort. The coal ran into the centre, but there was less possibility of jamming; and the poking hole was directly over the centre of the retort, instead of at the side. Attention was drawn to an improvement in the hydraulic main; the self-sealing cleaning lid having been enlarged to about three times the size of those on the first installation, giving greater cooling condensation; and the ascension pipe was so cleaned that any thick pitch was ready to be lifted off from the other end. The liquor arrangement had been magnified; so that, instead of going direct into the hydraulic main, as in the original installation, the gas rose as it entered the foul main, and the whole of the pipes were continually washed-out before it got into the hydraulic main.

The Visitors Entertained.

A dinner followed at the White Horse Hotel. Mr. Simpson, the Chairman of the Board, occupied the place of honour, and was supported by Mr. Toogood, Mr. E. J. Wellens, Mr. J. W. Lee (the President of the Association), Mr. Balmforth (the Vice-President), and Mr. F. Pickles (representing the Senior Association).

Mr. F. Pickles (Kildwick), in submitting the toast of "The Hebden Bridge and Mytholmroyd Gas Board," said what they had seen that day convinced them that Hebden Bridge had a very progressive Gas Board. Of course, it was no use having a good Engineer if the Chairman and members of the Board did not back him up. This was exactly what they had done, and the result was a vastly improved works. When Mr. Wellens first came there, he had untold difficulties to face—in fact, he (Mr. Pickles) knew from his own local knowledge that Hebden Bridge then had the most tumbled-down works in the country. To-day, they appeared among the most up-to-date.

Mr. Simpson, in responding, said the Board had had a long struggle,



The Members of the Yorkshire Junior Gas Association, on their Visit to Hebden Bridge on Saturday. Photographed by Mr. E. J. Wellens.

and he could tell them of difficulties overcome of which few of them would dream. Before they got the new holder, their principal holder was a mile and a quarter from the works; and they had only one main to it—a 12-inch one. This carried the gas to the holder at Mytholmroyd and then brought it back to supply Hebden Bridge and district. They had been advised to put down 18-inch mains; and this would be part of their future programme of improvements. If they were not up-to-date they were trying to get so, and they depended to a great extent upon their Manager.

Mr. ROPER (Bradford), an ex-President of the Association, proposed the health of Messrs. Robert Dempster and Sons, coupled with the names of Mr. Broadhead and Mr. Toogood.

Mr. TOOGOOD, acknowledging the toast, said he received a telegram from Mr. Broadhead stating he had been unexpectedly called away. Regarding the plant they had seen that day, it was started in July, 1911, when their first patent was taken out. Since then a lot of anxious hours had been spent upon the plant; Mr. Wellens and himself having revelled in difficulties. But their satisfaction was that success had brought its own reward. This was the first public inspection of the plant, which began working two years ago. The great difficulty with which they had to contend was the site; but the plant itself was exactly the same as laid down two years ago. It had been a brilliant success throughout, notwithstanding the site difficulty. The second bed now being installed was on the same lines as the first; there being no real change in the principle originally adopted, which had stood every test and come out triumphant.

The CHAIRMAN, in proposing the toast of "The Visitors," coupled with it the name of Mr. J. W. Lee, the President of the Association, and took occasion to assure the visitors that the new plant installed had been an unprecedented success.

Mr. LEE, in responding, in the name of the Association, said they had made many enjoyable and profitable visits, but none would live longer in their memory and stand out more boldly than the programme of that day. They had learned a good deal, and he was sure would often recall with happy thoughts their visit to Hebden Bridge. They had visited many works, but never one so "crabbed" and confined as that at Hebden Bridge. It showed how what looked like insurmountable difficulties had been overcome. They had certainly learned how not to design such a gas-works. But, assuming they had a similar situation to deal with, they saw how difficulties might be overcome. It was a useful object lesson. He could not do less than thank the Chairman of the Gas Board, the representatives of Messrs. Dempster. and Mr. Wellens, who had frankly told them everything they sought to know.

Mr. E. J. WELLENS, in moving a vote of thanks to the Chairman, said vertical retorts were not so well known four years ago as now. What they wanted at Hebden Bridge was a plant which would adapt itself to their particular site. Messrs. Dempster and Sons submitted a scheme which guaranteed to produce from 20 tons of coal 240,000 cubic feet of gas of a certain standard of illuminating power. The scheme was accepted; and the result was that it exceeded expectations—the output being 320,000 cubic feet. He had every reason to be thankful and gratified with the plant. He was convinced they were on right lines; and for this reason the Board, on his advice, had gone in for a second installation. He concluded by paying a tribute to his Chairman and the Board for their help and confidence, and congratulated Mr. Simpson on his appointment as a permanent Magistrate.

The CHAIRMAN, in acknowledging the vote, related a little story in connection with Mr. Wellens' appointment twelve years ago, and remarked that he had never had reason to lose confidence in him from the first day of his appointment—in fact, time had only strengthened it.

The Collective Gas Exhibit at the Panama Exhibition.

We learn from "The Gas Age" (New York) that the comments passed upon the collective exhibit in the Gas Pavilion at the Panama Exhibition on the opening day (Feb. 20 last) were numerous and favourable; and the opinion is expressed that the exhibit is a credit to the gas industry. It is situated in the north-west corner of the Manufacturers Building, and occupies 10,000 square feet of floor-space. There are six entrances to the Pavilion, and over two of them are placed art-glass signs with the words "Collective Gas Exhibit," while over the other four entrances are plate-glass signs, 36 inches long, with the words "Lighted by Gas." The ceiling is 14 feet in height, and in the centre of the building there is a dome 28 feet in diameter and 30 feet high. This dome is lighted by a large specially constructed fixture with eight gas arcs, controlled by mercury valves. There are 50 exhibitors, and spaces are partitioned off to accommodate the different displays. Between the stalls are solid partitions, 3 feet high, with railing, and entrances at the front. Handsome signs are placed 8 feet from the floor, with the name and address of each exhibitor painted thereon, which enables the exhibitor to make an individual display, and still gives an open effect which shows that the collective exhibit occupies the entire pavilion.

Eastern Counties Gas Managers' Association.—The fifty-second general meeting of this Association will be held at the Liverpool Street Hotel, E.C., on the 29th inst., under the presidency of Mr. W. B. Farquhar, of Ilford. According to the programme issued by the Hon. Secretary and Treasurer (Mr. Joseph Davis, of Gravesend), in addition to the presidential address, there will be a paper on "Factory Lighting: Some Recent High-Pressure Gas Installations," by the Vice-President, Mr. A. E. Broadberry, of Tottenham. Before assembling, the members and their friends will be entertained at luncheon on the invitation of the Directors of the Ilford Gas Company—the Chairman (Mr. William Ashmole) presiding. The usual dinner will be dispensed with. The President has issued a cordial invitation to those members who may be staying in London to visit his works on the 30th inst.

MANCHESTER DISTRICT INSTITUTION OF GAS ENGINEERS.

Coal Supplies Discussed at a Special Meeting.

A Special Meeting of members of the Institution was held last Tuesday, at the Grand Hotel, Manchester, for the consideration (in private) of a matter of particular interest at the present juncture. Subsequently, an informal discussion took place on the question of coal supplies and contracts for the ensuing season.

Alderman KAY (the Chairman of the Manchester Gas Committee) and Alderman PHILLIPS (the Chairman of the Salford Gas Committee) having reported the result of their visit, with representatives of Birmingham, Nottingham, Bradford, and Leicester, to the Board of Trade [see "JOURNAL for March 16, p. 645],

The PRESIDENT (Mr. J. G. Newbigging) said he regretted no reply had as yet been received from the Board of Trade. He expressed the opinion that if it were, as the Departmental Committee had said, a fact that 3s. a ton was the utmost cost that had been entailed on the colliery owners owing to the war, the Government should fix the prices of the various classes of coal according to this estimate, or even a little more. They, as gas engineers, did not disagree with the colliery owners recouping themselves for the extra cost that the war had entailed upon them—nothing was further from their minds.

The meeting also considered the subjoined circular-letter issued by the Lancashire Commercial Section of the Institution, and approved it. They recommended that a further conference of gas and electrical undertakings throughout the country should be called as speedily as possible. The matter was a national question, and it could only be effectively dealt with by the calling of a National Conference in London.

MANCHESTER DISTRICT INSTITUTION OF GAS ENGINEERS (LANCASHIRE COMMERCIAL SECTION).

RE—COAL SUPPLIES.

Dear Sir,—The question of coal supplies and prices was discussed at the last sectional meeting, and it was decided to suggest to each member the advisability of influencing his committee or directorate (including the electricity department) to pass and forward resolutions to local members of Parliament, urging the Government to consider the importance of taking immediate action with a view—

1.—To restrict the export of coal in order to ensure adequate supplies for the home demand, with particular reference to such public supplies as gas and electricity.
2.—To expedite matters, as urged by recent deputations, to secure better railway transit and more regular supplies of coal from the collieries, to meet the urgent and necessary requirements of gas and electricity departments.
3.—To take such action as they may deem expedient to prevent such unnecessary increases in the price of coal for next year's requirements as are now being quoted by the colliery owners, which will have a very serious effect upon the general welfare of the nation, as the increased working costs of public supply undertakings will necessarily lead to advanced charges for gas, electricity, &c.

Yours faithfully,
S. E. HALLIWELL, Hon. Secretary.

Gas-Works, Littleborough, April 9, 1915.

CONVERTIBLE COMBUSTION ENGINES.

As briefly recorded in the "JOURNAL" for the 2nd ult. (p. 528), a paper on the above-named subject had been submitted by Mr. ALAN E. L. CHORLTON, of Lincoln, to the Institution of Mechanical Engineers. The following is a more extended notice of the communication.

The author began by saying that it was not his object to advance the claims of either the gas or the oil engine, but rather to direct attention to the possibilities of a convertible engine designed to use advantageously both gas and oil. In surveying the problem in general, one might at first say that the combustion engine most ready to work on differing fuels would be of the self-ignition type, with a cycle approximating to that of constant pressure, in which the heat of compression is always sufficient to ignite the incoming fuel, whether solid, liquid, or gaseous, and the only change necessary in going from liquid to solid would be in the fuel-injection device. In practice, however, owing to the difficulty with solid fuel injection, such a type would not prove workable; and even when the fuel is first gasified the results do not justify the complication. Thus this type, while highly successful on oil, must suffer a radical conversion to use coal. The problem of designing an engine is better met, especially on the grounds of simplicity and suitability for every-day use, by trying to combine known types for gas and oil engines, in which good results are obtained at present, and which, in general principles, show like characteristics. Many of the types of engines in general use were therefore considered, as well as other methods presenting advantageous possibilities.

In the normal engines for both gas and oil, the chief difference lies in the degree of compression. Thus the compression of a

modern gas-engine using coal as its basis fuel may vary from 90 lbs. per square inch, when using coke-oven gas, to 150 lbs. per square inch for producer gas (and even higher if waste gases are used from blast-furnaces, &c.); while for the liquid fuel engine, using crude or residual oils, the compression pressure may exceed 500 lbs. per square inch, as in the case of a Diesel engine utilizing tar oil, but may be considerably less if the temperature of ignition is obtained by uncooled surfaces, or auxiliary or pocket firing is employed.

As there is no fundamental difference in engines for gaseous or liquid fuels, except in their conventional cycles, it follows that any schemes of convertibility must provide means whereby the requisite compressions can be readily obtained; but as between 500 and 150 lbs. there is a great gap, the tendency is for practical reasons to combine the lower compression oil-engine and the higher compression gas-engine, and thus deal with a smaller compression pressure range. The desirable characteristics of the convertible engine are: Simplicity and reliability; economy should be high for each fuel; first cost as little as possible above that of the standard engine for each fuel; easy convertibility; as near as possible the same power developed for each fuel.

The consideration of the subject may be more clearly undertaken by dividing the types of engines in use into three groups, with further subdivisions, due to certain peculiarities of design: (1) Engines of low compression and low power; (2) engines of high compression and higher power; and (3) engines of medium compression and higher power. As an example of the first group might be taken the ordinary motor-car engine, having a compression up to 90 lbs. per square inch, which, with slight modifications, would run on petrol or benzol, good paraffin with an exhaust heated carburetter, town gas, or producer gas made from coal or waste combustible materials. This motor was designed for, and would work best on, petrol. It would do fairly well, however, but not so economically, on town gas; but it requires very good paraffin, and is not very efficient at the low compression with producer gas.

To go farther and extend the range of fuels, to use a commoner paraffin or a good brand of crude oil, means must be provided whereby more heat is available for the ignition and combustion of the oil; and this can be conveniently done by the addition of an unjacketed portion to the cylinder end, when the engine becomes of the hot-bulb type. A change of parts for such an engine does not present any difficulties, and these can be readily made to give, with any adjustments of compression necessary for the producer, gas with the greater heat required for ignition and combustion of the oil. The gas-fittings are provided with electric ignition, which is also suitable when petrol is used; while the paraffin and good crude oil would be self-ignited by the hot bulb. [The author gave a diagram of an engine to illustrate the practical application of these modifications.]

The second group is represented by the Diesel engine, with a compression of over 500 lbs. per square inch, when using tar oils, unless an ignition oil is used. As the maximum compression for gas (in the normally used type of engine) does not exceed 150 lbs. per square inch, it will be readily seen that there are considerable mechanical difficulties in building, with a reasonable amount of modification, an engine in which both of these compressions can be obtained. Further, the Diesel engine has an expensive high-pressure air-pump, which is unnecessary for the ordinary type of gas-engine.

Apart from the mechanical difficulties, we may compare the commercial possibilities of this type, the oil and gas sides being as follows for engines of the same cylinder dimensions:—

	Compression.	Abnormal Maximum Pressure.	M.E.P.	Approximate B.Th.U. per B.H.P.-Hour.
Oil-engine	500	over 1000	100–110 lbs.	8000
Gas-engine	150	600	80 lbs.	8500

These figures show how incompatible the two designs are; for they illustrate that the Diesel structure must be built twice as strongly for the very high maximum possible pressure, due to the fuel-valve sticking, &c. The higher M.E.P. used is some compensation for this extra cost and weight. The mean cylinder pressures reveal a still further disadvantage when the gas conversion is considered, for there is, besides this high first cost, a reduced power, owing to working at a lower M.E.P.—80 lbs., as against 100 to 110 lbs. per square inch. A convertible engine on these lines does not seem a commercial possibility.

The range of the compression of engines with moderate compression suitable for developing higher powers (the third group) lies between that of the first and second groups, and is usually from 150 to 300 lbs. The compression of 150 lbs. is suitable for most forms of producer gas; but it is not usually exceeded, for the reason that pre-ignition of the compressed charge is more prevalent in very high-compression gas-engines. On the other hand, it is necessary for all compressions below that of self-ignition, as in the Diesel engine, to employ some auxiliary means to obtain the necessary height of temperature for the proper combustion of the residue oil.

The various devices employed in and around the question of temperature, compression, and convertibility of this group of engine may be considered by subdividing it under the following heads:

A.—Engines working with a compression not exceeding 150 lbs. both for oil and gas, and which may employ pocket-firing with or without air-injection for one and electrical ignition for the other, or some combination; the smaller compression not involving material mechanical change of the parts.

B.—Engines working with a higher compression for oil than for gas, involving some modification of the combustion chamber by the substitution of a part for oil as against a part for gas, but otherwise maintaining the simplicity of both types.

C.—Engines obtaining the necessary change from gas to oil by temperature control of the air charge, together with alteration of the valve-settings.

D.—Engines employing the super-compression of Mr. Dugald Clerk to control effectively thereby the compression required for either fuel.

Under subdivision A there are a large number of engines which are used only for oil, but which might, without material alteration, become effective in the use of gas, though the whole combination is not so efficient as the highest individual member. As an instance of this division, there is the two-cycle Bolinder engine, at present only used for oil, although originally used by Day for gas. When made with a stepped piston, with uncooled cylinder-head substituted by a water-cooled one, a gas-engine for small powers is more or less effectively obtained. A variation of this type, employing air-injection for the fuel, combined with pocket-firing for the ignition of the charge, secures considerable economy when used with oil. The advantage, however, in using more or less the same compression for both oil and gas is lost through the need of a high-pressure air-compressor (as with the Diesel engine) and the employment of double-injection needles. For higher powers and the best economies, it is necessary to go considerably farther; for, unless the economy upon oil is approximate to that of the Diesel engine, the convertible type will not become of any real lasting value.

In considering subdivision B, a useful comparison of its possibilities is given in tabular form for engines of the same cylinder dimensions:

	Compression.	Abnormal Maximum Pressure.	M.E.P.	B Th.U. per B.H.P.-Hour
Oil-engine	250 to 280	600	80 lbs.	8100
Gas-engine	150	600	80 ,,	8500

It will be seen from this that the outputs and general figures relative to the engine bear a great similarity. Further, diagrams actually taken when running on oil and gas are also shown to be of very similar nature. The possibilities, therefore, of this type of convertible engine appear, from these indications, to be very great; and an engine which has at present been made in considerable numbers to fulfil these conditions is one by Messrs. Ruston, Proctor, and Co., Limited. It presents all the ordinary features of the four-cycle engine, and the only change involved in converting from oil to gas lies around the combustion bulb of the oil-engine, in which the fuel oil is injected, and in the change from an oil-type to a gas-type piston. [In the accompanying diagram, fig. 1 shows the arrangement of parts when running on oil, and fig. 2 when running on gas.]

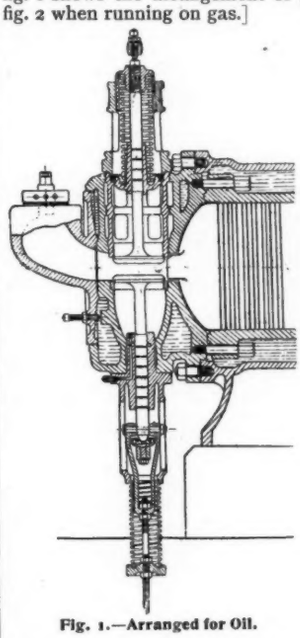


Fig. 1.—Arranged for Oil.

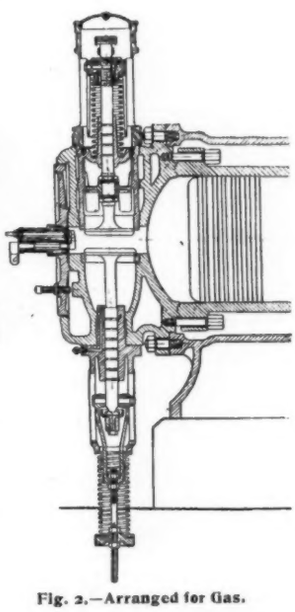


Fig. 2.—Arranged for Gas.

The use of the arrangements grouped in subdivision C may be said to be one of mechanical and constructional convenience, for they can hardly be defended on the score of efficiency. In one method the jacket of the cylinder cover or breach end is formed to withstand a pressure, and is worked in the manner of a boiler. The increased heat is impressed in the charge of air during the compression stroke to raise the temperature sufficiently to afford ignition. This arrangement thus replaces the hot-bulb or unjacketed end of the cylinder. It has some advantages, in that it

is perhaps more controllable, and the steam generated may be used for some useful purpose—perhaps in conjunction with an exhaust-heated boiler for an auxiliary steam-cylinder on the main engine. The water injection of some hot-bulb engines is also done away with. This type of engine is unusual in practice. When in use as a gas-engine, such a convertible engine would have to dispense with the pressure-jacket temperatures when using the lower compression and temperature needed for such an engine. Actual heating of the inlet air may be a practical convenience for dealing with a particularly refractory oil not amenable to the available compression of the engine. The valve-setting of an engine may be modified to give suitable compressions for oil and gas. This can be worked in conjunction with the temperature arrangement just described; but the gas-engine suffers in loss of output.

The Clerk super-compression engine (subdivision D) is a much more suitable and promising type for dealing with the variable compression problem of the convertible engine. In this engine, the principle of which is probably well known, an extra charge of air or inert gas is added to the working mixture at the end of the suction stroke. By this means, owing to the, so to speak, "watering" of the charge, much lower maximum flame temperatures are obtained and a higher mean cylinder pressure is rendered possible. For the purpose of the convertible engine it is mainly suitable, as by varying this amount of added air the compression can be adjusted between wide limits; the final temperature being controlled by any of the previously indicated means. For instance, with a compression of 300 lbs. maximum, the full displacement of the air-pump may be used; for the lower compression of the gas-engine one can, by any suitable valvular means, as an ordinary bye-pass, reduce the amount of discharge as required. The commercial value of this type has hardly been determined in practice; but it would almost appear that its possible usefulness will only come in for large engines; for after all it is an addition to, if not a complication of, the ordinary engine of every-day use.

The conclusion the author arrives at is that, for powers up to (say) 1000 B.H.P., the type of engine represented by the Ruston four-cylinder 520 B.H.P. is the most suitable as a convertible engine; while for still larger powers, when tandem engines and the size and weight of the removable parts become a problem, the Clerk super-compression type offers very interesting and hopeful possibilities.

SCOTTISH JUNIOR GAS ASSOCIATION.

WESTERN DISTRICT.

Annual General Meeting—Lecture by Mr. W. Cranfield.

The session of the Western District Division of the Scottish Junior Gas Association was brought to a close on Saturday, when the annual general meeting was held in the offices of the Lighting Department of the Glasgow Corporation in Trongate. Mr. David Fulton, of Helensburgh (who has succeeded the late Mr. Blair as Gas Engineer and Manager), the Vice-President of the Association occupied the chair, and explained that Mr. Thomas Carmichael, the President, had expected to be with them, but had been detained through pressure of business. He complimented the Association on the high quality of the papers read, and on the interesting nature of the discussions.

Annual Report.

Mr. Malcolm Littlejohn, the interim Secretary, in reading the annual report, which showed a balance in favour of the Association, said that during the session only five meetings and two visits had taken place; the curtailment being due to the war. There were eighteen new members, and fifteen resignations had taken place. Twenty-three of the members were serving with His Majesty's Forces.

Mr. Fulton, who is the President for next session, explained that this number represented 12 to 14 per cent. of the membership. The session's work had, he stated, been very satisfactory. The quality of the papers had been well up to the standard of previous years, and he thought a great deal of them. The discussions had been very lively, and the attendances good in the circumstances.

New Office-Bearers.

The names of Mr. David Marwick (Dawsholm), Mr. Alex. Wright (Lockerbie), and Mr. G. T. Purves (Auchengeich) were all proposed for the position of Vice-President; and the voting resulted in the election of Mr. Purves. Mr. James S. M'Nicol (Dawsholm) was re-elected a member of the Council; and the following new members were appointed to fill the vacancies on that body: Mr. Alex. Wright (Lockerbie), Mr. John Taylor (Glasgow), Mr. Archibald Stewart (Airdrie), Mr. D. Marwick (Dawsholm), and Mr. J. Jamieson (Thornliebank). As Mr. Cubie is serving with the Colours, Mr. Littlejohn was reappointed as interim Secretary.

Lecture by Mr. William Cranfield.

The Chairman, when introducing Mr. William Cranfield to deliver a lecture on "The Essentials of Modern Gas Composition," said he was known throughout the country as one of the most successful tutors connected with the gas industry. He had had students from Land's End to John o' Groats. His work in connection with the Yorkshire Junior Gas Association was particularly noteworthy, and he had had a good deal to do with its success. He was specially entitled to the thanks of the Juniors, and had something to do with the inception of their Associations.

Before delivering his lecture,

Mr. Cranfield conveyed to the members the cordial greetings of the Yorkshire Association, who were also, he said, holding a meeting that day. He would not say that Yorkshire looked up to them as the leading Junior Association; as no Association thought that of any other. But they held them in very special esteem as being a particularly go-ahead Association. He then proceeded with his lecture, which will be found on p. 139.

The Chairman, in inviting a short discussion on the lecture, said he thought the members would agree with him that Mr. Cranfield was a very worthy successor to the gentlemen who had previously delivered the annual lectures to the Association. He had provided them with subjects which gave them food for serious consideration. Those who struck out on new lines were apt to meet with opposition. He thought Mr. Cranfield would meet with opposition in some of the views he had expressed; but they must all admire one who had truly the courage of his convictions.

Mr. Alex. Wilson (Glasgow) said they had listened to a very able lecture, and what they had heard would repay going over again very carefully. To some of them (the older hands) it appeared like the dressing-up of old principles in new ways. All who had studied the subject of gas supply closely and continuously would find that they must agree with Mr. Cranfield's main statements. They had tried in the past to make the best of the materials to their hands, and do the best with the appliances they had. Some spirits wanted to excel and show big results; but those which appeared big in one way were not always giving to the consumer the value which every true manager would like to give. The results that were obtained in the way of extra cubic feet of gas per ton, though looking well on paper, did not perhaps carry to the consumer the value of a less make per ton of coal carbonized. The cleaner and the more regular they made their gas, the better they would satisfy the consumer. A number of years ago he was called into works where many complaints were coming in from consumers. In the works they held that the whole thing lay in giving a high-quality gas—a minimum and above it. But the gas was not regular. He advised them to keep down to the minimum quality, and supply it regularly. Since that time the quality had been reduced in the district, and there had been few complaints. They had not many complaints as to the quality of gas in Glasgow. They did not make water gas, and did not enrich. Theirs was a straight coal gas, and they tried to get the quality as regular as possible. When once appliances were adjusted and the gas regularized, there was not so much trouble as in having gas of high quality at one time and low quality at another.

Mr. John Wilson (Falkirk) thought the salient features of the lecture were constancy and flame temperature. Mr. Cranfield had said that the retort-house governor was not of much use in relieving the surging that took place in the hydraulic mains. Was this surging due to the action of the gas in gulping from the dip-pipe or to the pulsation of the exhauster? If it was due to pulsation, was the governor not useful in alleviating the surge? He thought the summary at the end of the lecture should be framed and hung up in every works.

Mr. John Frazer (Dalmarnock) agreed with Mr. Cranfield that the district was the proper place in which to test the gas, and not the works. In Glasgow, where they did not enrich, the gas leaving the works was practically the same as it was in the districts. With reference to the increase in pressure, would it make any perceptible difference in the leakage of gas? If a pipe would stand 2 inches pressure, it would stand 22 inches. He failed to see how, running with a seal of 0·5 inch or less, they would get a pulsation of 6 inches. They only had the pulsation in the liquid in the main. He was a believer in the dry main. But there was one thing he would like to have explained. In some works—as in Belfast—they worked with the dry main and had trouble with dust. If they worked with a ½-inch seal, they caught the dust and got rid of it.

Mr. Cranfield explained that he had really hardly prepared his lecture for discussion, but had "rung out" into it the essence of some of his deepest convictions. The members could pick out things open to criticism and assailable to onslaught (such as his reference to lower-grade gas), they could also pick out matters of opinion; but he was convinced that he had been dealing with things that mattered, and mattered pre-eminently. If he might be allowed to say so, even should the lecture not repay subsequent reading, the topics raised would repay subsequent thinking. He felt indebted to Mr. Wilson and flattered by his approval. Explaining that it was imperative that they should distinguish between two oscillations, he said that that which was caused by the gas bubbling in the end of the dip-pipe would not be affected by the retort-house governor. Regarding the 6-inch waves, they had been repeatedly seen through observation windows in two important works in Yorkshire. The size of the waves produced in the hydraulic mains was hardly realized. Leakage in the mains was dependent upon the size of the opening, and, to a slight extent, upon the specific gravity of the gas and the pressure. It had nothing to do with the feed of the gas. He did not think the difference between 1 inches and 2 inches of pressure would mean much. He agreed that a dry main might leave something to be desired in the catching of dust. Personally, he strongly favoured dry mains—more particularly those which could be converted.

TESTING OF MATERIALS.

At the Meeting of the Institution of Mechanical Engineers on Friday last, Mr. W. CAWTHORNE UNWIN, F.R.S. (the President), devoted the closing portion of his Inaugural Address to the subject of the testing of materials. His remarks were as follows.

Half-a-century ago, most materials of construction were selected and bought on the reputation of the manufacturer. Experience roughly indicated the sources from which the most reliable supplies could be obtained. Now hardly any material in large use is accepted without special testing in the interest of the purchaser. Such testing is primarily intended to distinguish suitable and unsuitable material and to protect the user from carelessness or fraud. But it has also acted as a stimulus to manufacturers to standardize and improve their products. Once it is known how good a quality can be produced, all manufacturers strive to reach it, and the average quality is raised. The rapid development of cement and of the higher qualities of steel has depended on the determination of their superiority by accurate tests in the properties required for special services.

With the introduction of mild steel, the quality of which ranges between wide limits, the need of systematic testing became urgent. Now there are testing laboratories in the works of most railway companies and in steel-works. Also the practice of testing has been adopted in the case of many other materials. With the extension of testing has come the need of standardizing tests themselves—a work largely accomplished by the International Association and the British Standards Committee. But with the increasing stringency of specifications, perhaps more attention should be given to the calibration of all the instruments used in testing. In physical investigations, great attention is given to the determination of the errors of instruments and methods; and perhaps in material testing this has received too little attention. I do not suppose there are important errors in the indications of large testing-machines, though a comparison of results in different laboratories would be interesting. Errors in subsidiary apparatus are probably more frequent. It is possible with a standard bar and a good extensometer, used by the same practised observer, to measure the agreement or disagreement of different testing-machines. I have found also the use of copper cylinders subjected to crushing to be a very convenient means of checking the load indications of machines.

On the Continent and in the United States there are public laboratories, supported by the State, where anyone can have tests made, at moderate fixed rates, by a trained scientific staff and with great accuracy. Such institutions assist industry if, on the one hand, they meet industrial requirements, and, on the other, are unbiased by private interests. They have the advantage over private laboratories that they are under the direction of experts of exceptional experience and reputation, and are able to pursue investigation, continued often for long periods, beyond immediate requirements into fruitful by-paths. The view taken in Germany is that the work accomplished is partly of advantage to the manufacturer who calls for assistance, and so far should be paid for by him, and partly is of advantage to the nation in advancing science, which is the justification for a State subsidy. Hence it is incumbent on the public institution to publish results as freely as is possible without injuring private interests.

At Grosslichterfelde the annual income from fees for testing amounts to some £20,000, and the annual State subsidy is £12,000. On the staff there are 230 persons, of whom 75 have had University training and 38 Technical High School training. Since 1880 the work accomplished has steadily and regularly increased. The Bureau of Standards at Washington is on a still larger scale, and does very similar work. It receives an annual subsidy from the Federal Government of £100,000. The equipment is extraordinarily complete. For instance, it has a 600-ton testing-machine at Washington, and a 1000-ton one at Pittsburg, both of the highest sensitiveness and accuracy. Such machines do not exist in this country. Happily we have a similar institution in the National Physical Laboratory at Teddington. Its functions are somewhat restricted by the characteristic English jealousy of State action, which I think is diminishing. It would be difficult to over-estimate the service it has done in the solution of various mechanical, electrical, and physical problems which were unlikely to be attacked by private persons. Some of the researches started by the Institution have been carried out there, and valuable papers contributed to the "Proceedings."

It is a condition of commercial testing that the results should be available in a short time and at small expense. Hence ordinary tests are of a somewhat arbitrary character, and do not completely imitate the conditions of actual service. We test specimens of steel to destruction, and measure ductility by plastic deformation, though in use the stresses do not exceed the elastic limit, and the deformation is elastic. We test cement in tension and use it in compression. There is need for constant criticism of methods of testing and for the invention of new tests, such as tests for hardness and brittleness, though new tests must be cautiously introduced.

One small change could easily be made, and in some cases would be interesting. When a set of tests on a material has been made, the mean of the results is taken as the best value of the property measured. In physical investigations generally a further step is taken by calculating what is termed the "probable error," which, broadly, is a measure of the trustworthiness of the results. Calculation of the probable error is troublesome; but Professor Martens [Director of the State Laboratory at Grosslichterfelde] has pointed out that the "mean error" is nearly as accurate, and good enough for practical purposes. The mean error is the sum of the deviations of the individual results from the mean, irrespective of sign, divided by the number of observations. The mean error is conveniently expressed as a percentage of the mean value. If the mean error is large, the method of testing, the uniformity of the material, or the preparation of the test specimens is at fault. Generally the source of the error can be inferred. A large mean error in tests of steel would indicate want of uniform quality in the material; in cement, probably faults in preparing the test briquettes. Of two supplies of a material, that with the smallest mean error is preferable.

There is another kind of testing, likely in the future to be of increasing importance—that is, the measurement of strains in members of completed structures, so as to determine the stresses to which they are actually subjected in service. Strain measurements on the members of bridges during the passage of trains have been made in Holland, in France, by Mr. La Touche and Mr. Sales in India, and by Professor Turneaure in the United States. These observations throw light on two points—the trustworthiness of theoretical calculations of the stresses and the magnitude of the stresses due to dynamical actions which cannot be calculated. Recently Mr. I. E. Howard, Engineer-Physicist at the Bureau of Standards, has initiated a very extensive investigation which is to extend to large bridges, the Panama lock-gates, and steel-framed buildings. Some results on the stresses in the shell of a simple cylindrical tubular boiler have been published. A cylindrical boiler shell is a very simple structure, and the straining action is statical. It might be expected that theoretical calculations of the stresses would in that case be approximately verified by the observations. In fact it is not so. The distribution of stress is very much less uniform than it is assumed to be in theory and in the design of boilers. Of course, this is chiefly due to angle-irons and joints, which in most cases reduce the stresses, but, at any rate, greatly modify the stress distribution.

ROAD REINSTATEMENT AFTER MAINLAYING.

In the course of a discussion at the Society of Engineers last Tuesday, upon modern methods of road construction and maintenance, in connection with a paper by Mr. FRANK GROVE, the Assistant County Surveyor of Surrey, some comment was made upon the alleged inefficient manner in which gas and water undertakings reinstate the roads after laying new mains or repairing existing ones.

Mr. W. MENZIES, the Surveyor to the Egham Urban Distric Council, said that damage to roads as a consequence of work done upon gas and water mains, sewers, &c., was one of the most trying things which surveyors had to put up with. The trenches were usually left in a horrible state by the various people empowered to open the roads; and he suggested that the Road Board, or some other authority, should, as soon as possible, introduce legislation or secure some means by which the various gas, water, and other authorities who now destroyed the roads at their will and snapped their fingers at the road authority should be forced to do something to restore the surfaces to their original condition.

Mr. PERCY GRIFFITH pointed out that gas and water authorities did not open the roads for amusement, and that their work was indirectly, at any rate, for the benefit of the community. For instance, even the repair of leakages reflected upon the price of the article, and the consumer benefited. The repairing of trenches was a difficult matter; and if the local authorities could devise some method by which the pipes could be laid otherwise than in the native soil under the road surface, he did not think any of the gas or water authorities would object. In other words, if a subway could be provided, the pipes would be put there willingly. It should also be remembered that it was now the general custom to arrange with the local surveyors to carry out the resurfacing of the roads after they had been dug up by gas or water authorities, so that there could be no complaint against the latter for inefficient work so far as the top surface was concerned.

Mr. E. H. COLECUTT called attention to the fact that it was the filling-in of the trench which was badly carried out; and this was usually done by the gas or water authority. The surveyor only took over the repairing of the surface, which was a comparatively easy matter. It was the subsidences due to the bad filling-in of the trench which had to be avoided.

The PRESIDENT (Mr. Norman Scorgie) said that, no matter how careful they were in reinstating a trench, it was practically an impossibility to get the road in exactly the same condition as it was before. He likened it to a new coat being torn; no amount of mending would make it look absolutely a new coat again.

Mr. GROVE, in the course of his reply, mentioned that the Surrey County Council this session, in connection with certain Bills, intended to ask Parliament to give them authority to take over the trenches immediately the gas or water authorities had finished the work upon their mains, and allow the surveyor to do the filling-in as well as the finishing of the top surface.

GAS FOR INDUSTRIAL USES IN AMERICA.

The use of gas for industrial purposes was the subject of a paper read by Mr. J. C. SHEPARD at the last meeting of the Indiana Gas Association. In the course of it he gave the following particulars of installations of plant operated by gas.

In his introductory remarks the author expressed the opinion that in soliciting industrial business it is not always good policy to attempt to estimate the cost of gas for comparison with other fuels, because in most cases it is higher, if fuel cost alone is considered; but apart from actual fuel cost, everything else is usually in favour of gas. Careful investigation should, he said, be made in each case, and as much information as possible obtained; and if it is found that gas has even a fighting chance, it has been found good policy to arrange for a trial installation, provided it can be done without building special appliances or going to any great expense. A trial of the proper appliance under working conditions brings out the advantages of gas in a very convincing way. The sale of gas lights, irons, room-heaters, and automatic water-heaters has been greatly increased by trial installations. Industrial business is more desirable; and much of the future increase in gas sales must come through the use of gas for industrial purposes. Gas companies should be willing to show people the advantages of gas for manufacturing purposes before expecting them to adopt it as a fuel.

Trial installations are the entering wedges that give the salesman access to the factory; and while the appliances are being demonstrated, he is not only collecting data which will be of value in soliciting this class of business in other factories, but he becomes acquainted with the operating conditions which must be dealt with—such as the class of labour (piece or day work), the quality of work, speed of handling, kind of fuel used, and facilities for storing and handling, fire hazard, and shop management, any of which may have a deciding influence. Getting into the factory and working out the problems of the manufacturer and educating him and his employees to the advantage of using gas, has a great deal to do with landing the big and profitable business, but business difficult to secure. In most cases it is the increased output (quicker work) or improved quality of work from better heat control that gas suppliers are able to show, and the service that goes with the appliance rather than a lower fuel cost, that influence the manufacturer in using gas.

With these prefatory observations, the author passed on to give some instances of the successful introduction of gas for industrial purposes. He said that at Evansville the manufacturers have the advantage of probably the cheapest coal in the country—from 25c. to 60c. per ton for slack or steam coal to $1.50 per ton for the best grade of lump coal at the mines, some of which are located within the city limits. Until a few years ago very little gas was sold for industrial purposes, and at present the surface has only been scratched. The first attempts to introduce gas for industrial purposes met with very little encouragement—usually with the objection that the cost would be prohibitive. When the author found that this was the principal objection, it was decided that he must get a customer into a "show me" frame of mind to put in a trial installation to determine what could be done with this class of work. It is found that the use of gas in any factory will increase after it has been once introduced.

In connection with one of the leading industries a furnace was installed for annealing the ends of brass pipe, on a thirty days' trial; and it was found that the work could be done in less than half the time required with a coal-forge, and with no danger of spoiling the material by overheating. The furnace consumed about 125 cubic feet of gas per hour, costing 11·8c.; but the saving in labour more than offset the increased cost of gas over other fuels. After seeing the results obtained on this furnace, an order was placed for an oven furnace for tempering tools, soldering furnaces of the blast-burner type, and brazing burners. These appliances are not used continuously; but they consume on an average 22,200 cubic feet of gas per month, or 226,500 cubic feet per annum.

The economy shown in operating these appliances led to the installation of a brass-melting furnace. During a test, 16,345 lbs. of brass was melted with a gas consumption of 208,800 cubic feet, or 1271 cubic feet per 100 lbs of brass. As this consumption was high, and the furnace was not economical to operate on manufactured gas, another make was tried. On the new unit they melted 47,980 lbs. of brass with a gas consumption of 273,700 cubic feet, or an average of 570 cubic feet of gas per 100 lbs.; and it was discovered that a crucible would last twice as long in a gas-furnace as in a coke-fired furnace. This foundry turns out upwards of 400,000 lbs. of finished brass castings a year, and the opportunity for developing a large consumer was very favourable. A desire to obtain the most economical results for the consumer led to the trial of the Fisher type of furnace, which had met with such decided success in other cities. From a four-and-a-half days' test on this type of furnace we obtained the following results:

Time of operating	33 h. 7 m.
Number of heats	30
Weight of brass melted	7790 lbs.
Gas consumed	28,790 cub. ft.
Average gas per 100 lbs. of brass melted	369 "
Average brass melted per day	1731 lbs.
Average number of heats per crucible	40

Further tests made by the foundry foreman showed that the speed could be increased considerably; but doing this beyond a certain point increased the consumption of gas per 100 lbs. of brass melted. His figures showed an average of 387 cubic feet of gas per 100 lbs., and an average of 2500 lbs. per day. The furnace has not yet been accepted by the customer; but he and others who melt brass have been convinced it can be melted with the quantity named. This one installation, if successful, will use approximately 180 million cubic feet of gas a year. The installation created keen interest in the minds of other manufacturers of brass goods, and the results put the use of gas into their calculations when considering the cost of every item in the casting of brass—such as speed of output, housing space, labour conditions during summer-heat periods, saving in the hauling of coke and ash, and many other advantages.

The Evansville Metal Bed Company have a brick oven, 17 feet long, 9 feet wide, and 9 feet high, built to burn soft coal, used for baking Japan on bed-springs. After considerable effort to sell them an oven designed to burn gas, for $425 installed, the author proposed to instal pipe burners and equip the old oven for gas for the cost of labour and material to make the change. Two 2-inch pipe burners of the atmospheric type were installed with 6-inch baffle-plates over the burners to prevent the Japan from dripping on to them aad catching fire. Pilot-lights were installed for safety in lighting, and dial-cocks put on the main burners for ease of regulation. With the steady heat from these powerful burners the oven turned out approximately twice the work, and of better quality, than it did when fired with coal. This oven consumes about 350 cubic feet per hour, maintaining a temperature of 380° to 400° Fahr., and is run only in the afternoon. The cost of gas is considerably higher than that of coal; but the saving in labour and the better quality of work have supported the claim for gas, and the consumer is satisfied.

The author gave the following figures in regard to the use of gas for roasting coffee. The machine was of one bag capacity; and the following results were obtained from a 2½-hour run:—

Weight of coffee roasted	1183 lbs.
Gas consumed	1000 cub. ft.
" " per 100 lbs. of coffee roasted	84·5 "
Bags of coffee roasted	9
Average weight per bag	131 lbs.
Average time per bag	14 minutes.

The author considers that probably hotels and restaurants offer greater opportunity for increasing gas sales than any one class of business, because in every town large enough to support a gas company there are hotels and restaurants. This business is hard to get, and the most difficult of all to keep. He described an installation which had actually regained business. The hotel in question at one time used gas for cooking, but discontinued it on account of the high bills. In 1912 the author's sales department took up the matter again, and obtained an order to instal two sections of the latest improved hotel range. After this range was put in, meter reading was taken daily, and the cost of operation for each day was placed on the steward's desk. The range was used 18 hours per day, and from the daily consumption it was thought that a saving could be effected by installing a short-order range so that the large range could be turned off after the regular meals had been prepared. A standard cabinet range top with a lighter was placed on the old coal-range and used for short-order work. This showed a saving of about 20 per cent. of their bill. The equipment was used for about six months before the manager decided to remove the remaining coal-burning equipment and complete the installation of gas appliances, consisting of a double section short-order range, broiler, baking-oven, and combination cake griller and toaster. The hotel has probably the largest patronage of any one in the city; and after this installation was made others followed. The author added that a large proportion of the total increase in the gas sales in Evansville for 1913 and 1914 was due to industrial and hotel and restaurant appliances.

MANUFACTURING LABORATORY AND INDUSTRIAL GLASSWARE.

Research by the Institute of Chemistry.

The "Proceedings" of the Council of the Institute of Chemistry for February and March, of which we have received an advance proof, furnish particulars in regard to investigations which have been carried out by a Committee of the Institute with the view of arriving at suitable formulæ to be available to manufacturers who are willing to assist in maintaining the continual supply of glassware for laboratory and industrial purposes, which has considerably diminished as a consequence of the war. The Committee was appointed last October, and consisted of Professor Raphael Meldola (then President of the Institute), Mr. Bertram Blount, Mr. Otto Hehner, Professor Herbert Jackson, Mr. Walter C. Hancock, and Mr. T. R. Merton. At their first meeting Professor Jackson reported that, in conjunction with Mr. Merton, he had already commenced experiments at King's College with a similar object in view, and that he and his collaborator were prepared to give the Committee the results of their work up to date, and to pursue investigations on lines to be determined. Since then the research has been continued uninterruptedly; the chief aims being to produce working formulæ for all glasses used in laboratory work, and to ascertain the influence of various ingredients on

the physical and chemical properties of glasses. The work has involved a careful study of the chemistry of silicates, aluminates, borates, &c., in their relation to the manufacture of glasses; and it is intended to publish a detailed report of these experiments.

Up to the present, the Research Committee have reported eleven formulæ for glasses for various purposes, based on the results of about 400 experimental melts on a scale large enough for drawing rods and blowing small vessels. In addition, a great number of experiments were made in order to study the influence of the various constituents employed. The following are some of the formulæ decided upon. They have been submitted to a number of manufacturers who have expressed their interest in the progress of the investigation, as well as to scientific workers who are conducting similar experiments.

Soft Glasses, Suitable for Chemical Laboratory Ware.

	Parts.
Sand	67·0
Sodium carbonate (Na_2CO_3)	34·2
Calcium carbonate	11·6
Alumina (Al_2O_3)	6·5

A soft glass which does not give up alkali readily to water, works well in the blowpipe, and does not readily devitrify.

Sand	67·0
Sodium carbonate (Na_2CO_3)	29·0
Calcium carbonate	9·6
Calcium fluoride	1·6
Alumina (Al_2O_3)	8·3
Boric anhydride (B_2O_3)	2·0

A soft glass of higher quality. Does not give up alkali under severe tests. A kindly-working glass before the blowpipe, and very difficult to devitrify.

Glasses for Combustion Tubing.

Sand	68·2
Alumina (Al_2O_3)	6·2
Barium carbonate	8·8
Calcium carbonate	13·0
Potassium nitrate	4·3
Sodium carbonate (Na_2CO_3)	5·5
Boric anhydride (B_2O_3)	5·5
Calcium fluoride	1·0

This glass resembles Jena combustion tubing very closely indeed. It has practically the same fusing-point. It fuses on to Jena glass perfectly, and is indistinguishable from it before the blowpipe and in its behaviour on prolonged heating below its fusing-point. The presence of the small quantity of calcium fluoride facilitates the incorporation of the ingredients. The sodium carbonate can be reduced to 1·34 parts provided 7·93 parts of anhydrous borax be used in the place of the boric anhydride.

Sand	68·2
Alumina (Al_2O_3)	6·2
Barium carbonate	8·8
Calcium carbonate	14·2
Potassium nitrate	4·3
Sodium carbonate (Na_2CO_3)	5·5
Boric anhydride (B_2O_3)	5·5

This glass is practically of the same composition as the preceding. It is not so easy to make or to work; but it does not become so opaque as Jena combustion tubing on prolonged heating. As in the preceding formula, the proportions given for sodium carbonate and anhydrous borax can be substituted for the figures for sodium carbonate and boric anhydride.

Alternative for Combustion Tubing.

Sand	72·0
Alumina (Al_2O_3)	10·0
Calcium carbonate	11·0
Magnesia (MgO)	0·5
Potassium nitrate (KNO_3)	3·0
Sodium carbonate (Na_2CO_3)	11·2
Borax anhydrous ($Na_2B_4O_7$)	7·2

This glass is capable of withstanding high temperatures and rapid changes of temperature, works well before the blowpipe, and is free from the chief defect of Jena glass—viz., the readiness with which it becomes cloudy and finally quite opaque after prolonged use. By slight modifications of this formula, almost any degree of hardness can be obtained.

The Committee consider that the formulæ they have obtained and the work they have done on the various glasses justify them in the opinion that there is now information available for the manufacture of all the important glasses used in the laboratory and for industrial purposes, which have hitherto been mainly obtained from abroad.

Brazilian Monazite Sand.—According to a United States consular report, most of the very limited supply of extracted monazite sand lies at present in Europe. So far as can be ascertained, it does not exceed 8000 to 9000 tons, obtained chiefly from Brazil and British India. The following analysis of Brazilian monazite sand was furnished by Mr. F. H. Lee, who is associated with the Geological Service of the Brazilian Government: Phosphoric acid (P_2O_5), 29·28; cerium oxide (Ce_2O_3), 31·28; lanthanum oxide (La_2O_3) and didymium oxide (Di_2O_3), 30·88; silica (SiO_2), 1·40; thoria (ThO_2), 6·49; loss on ignition, 0·20—total, 99·53. Mr. Lee states that no complete analysis of the sand as found in Brazil is known to him; and that the mean thorium oxide content of the product regularly marketed from the only sources thus far found to be commercially payable ranges from 5·75 to 7·1 per cent. The product marketed in Brazil carries about 92 per cent. of pure monazite, and runs from 6·2 to 6·4 per cent. of thoria.

LEAD-WOOL JOINTS FOR GAS-MAINS.

Results of its Use in Chicago.

At the last Meeting of the Illinois Gas Association, a paper on the use of lead-wool joints for gas-mains was read by Mr. C. E. Reinicker, of the Engineering and Street Departments of the Peoples Gas Light and Coke Company of Chicago (Ill.). In it he set forth the causes, and gave an account of the experiments, which led the Company to adopt the material named for jointing their mains, and described the installation of a 36-inch gas-main in order to illustrate the Company's practice in relation to this matter.

The author introduced his subject with some historical particulars, from which the following are extracts: Germany is the pioneer in the use of lead-wool, since in May, 1904, August Bühne, of Freiburg, began to supply the gas companies of that country with "*blei woole*," or lead-wool. Quick to realize its advantages, operators adopted it to a great extent; and, as a result, its use rapidly spread to other countries. In a short time it was protected by upwards of 43 patents in all civilized countries; the first one being filed in Washington by Herr Bühne on June 15, 1904, and the patent granted on April 11, 1905. Plant was immediately started for the manufacture of lead-wool at Snodland, in Kent; and shortly afterwards its commercial introduction into America was undertaken, though some of it had previously been directly imported for the use of the Consolidated Gas Company of New York.

Early Work with Lead-Wool.

The first consignment of lead-wool for the Peoples Gas Company reached Chicago in August, 1906, when 100 lbs. was received from the New York Company just named. In the early part of the following year several small lots were purchased by the Company for experimental purposes; and towards the close of 1907 its use was undertaken in the installation of the piping for the exhauster-house at one of the stations. Following this installation, the material was used in other manufacturing plants in various parts of the Company's property. The work was accomplished by hand caulking; the comparatively small number of joints on each individual installation rendering less conspicuous the excessive cost which would be represented in a long line of street main installed by this laborious method. In 1909 the first gas-main (a 12-inch) was laid with lead-wool joints; and in 1910, a 6-inch main was put down—both the mains in question being hand caulked.

Results with Various Sized Mains.

In the interval from 1907 to 1911, between 200 and 300 lead-wool joints of all sizes, and operating under all conditions of temperature and vibration, were installed in the various manufacturing plants and exhauster-houses. In July of the latter year the Company desired to obtain information on the condition of these joints; so the author was commissioned to undertake a systematic examination of as many as were exposed. During this investigation, over 200 joints were carefully—almost minutely—inspected. They ranged in size from 12-inch to 36-inch; the bigger sizes, from 24-inch to 36-inch, being a large proportion of the total. Of the number investigated, none showed leaking gas or condensation. On the face of the lead of eight small globules of tar were standing; and, in addition to this, four showed a slight seepage of oil. On a percentage basis, only 5·9 per cent. were other than "bottle-tight." "Truly," says the author, "a remarkable record, since only a few of the joints—not exceeding twenty in number—had been recaulked or refaced since they were first installed."

Comparisons with Cast-Lead Joints.

Between the years 1907 and 1911, the Company had been steadily changing their distribution system from one of straight low pressure to a combined feeder-line low-pressure system; the gas being transferred from the former to the latter lines by 12-inch governors. This necessitated the converting of many existing mains and the laying of new lines 24, 20, and 16 inches diameter. Both the converted and the new mains were equipped with cast-lead joints, except that in the summer of 1911 some 2½ miles of 24-inch cement joints were installed. All new mains were put under a test of 15 lbs. air pressure, and the joints carefully gone over with soap and water—being absolutely tight before the trench was filled-in. Notwithstanding these precautions, and the fact that all mains were laid under careful supervision, a great many of the joints of both kinds absolutely failed to stand under 5 lbs. of gas pressure, necessitating continuous overhauling. As an additional complication, the problem of electrolysis had to be solved; and in this case, as in the consideration of the mechanical features involved, there seemed to be no agreement between gas engineers. While the question was being discussed and considered from all points, great trouble was being experienced from this agent in both lead and cement jointed mains, particularly in the neighbourhood of power houses.

Lead-Wool for Jointing a Large Main.

With the approach of 1912 it became evident that it would be necessary to lay a 36-inch main from one of the Company's stations to another, the distance between the two being about

13·3 miles. After the route was selected, the next problem which confronted the distribution department for solution was that of a suitable jointing material to be used. In view of the poor record which cast lead and cement joints were showing, it was self-evident that a material differing from these would be necessary, or continuous expense would result. In the hope of enabling a decision to be come to regarding a caulking material which would successfully meet the needs of the occasion, it was deemed advisable to conduct a series of tests embracing both mechanical and electrolytical features. Accordingly the author was instructed to conduct such tests, and, approaching the subject with an unbiased mind, endeavour to suggest some solution of the problem. The tests were made with a 6-inch pipe on a laboratory scale; and he says "they distinctly showed the superiority of lead-wool over other materials for pipe-jointing purposes, both from a mechanical and an electrolytic standpoint." Since the condition of the lead-wool joints in the manufacturing plant of the Company was giving such satisfaction, it was decided to equip the large mains with this material until such time as it failed to show efficiency, or until some more suitable material, or a better type of joint, was discovered.

Pneumatic Caulking.

With the question of the material decided, the next matter to be considered was its caulking. Owing to the cost of hand caulking, as proved in the joints already installed, this method was not to be thought of in connection with the long line. After careful consideration of all existing conditions, it was finally agreed that pneumatic caulking was the only available method productive of economy; and steps were immediately taken to put this style of operation into effect. For a period of a month, 53 men received instruction and training in this method of caulking. In order to give them experience under conditions approaching as nearly as possible those which would exist, a 36-inch joint, made of a short bell and a short spigot piece of pipe, was used. In the period named, 76 joints were caulked and 4 or 5 tons of lead-wool used. A close record was kept of the performance of each man, both as regards the time of operation and the material used, and by this means a fair comparison of the relative merits of the operators was made possible. To determine the correct amount of caulking material which should be used, other 36-inch joints were made up with both lead-wool and cast lead, driven up with pneumatic tools and also by hand. After the joints were completed, the bells were broken, the quality of the joints was noted, and samples were taken in order that specific gravity tests might be conducted. From the report of the testing laboratory, four samples thus taken showed as follows:

	Sp. Gr. of Section as Caulked.	Sp. Gr. of Inner Ring as Caulked.	True Sp. Gr. by Fusion.
Lead wool, hand caulked	10·79	10·61	11·30
Do., pneumatically caulked	11·11	11·26	11·34
Cast lead, hand caulked	10·84	11·15	11·36
Do., pneumatically caulked	11·29	11·09	11·32

As will be noted from the above table, the samples of joints which were pneumatically caulked are uniformly more dense and their specific gravities nearer to the true specific gravities than are the hand-caulked samples. It may also be remarked that the gravity of the ring of lead-wool at the back of the recess in the bell is more dense, and its specific gravity nearer to the true one, than is a like sample from the cast-lead joint. Therefore this test tends to show that the best and most uniform results are obtained from lead-wool caulked with pneumatic hammers. Similar tests, made from samples taken from bells which split after caulking during the installation of the main, were a means to determine whether or not this standard was being maintained.

The total number of joints caulked by means of the methods previously described was 5917. The average cost per joint was $7.46, divided into $1.04 for labour and $6.42 for material. The average weight of the latter used in each joint was 6·2 lbs. of yarn and 72·4 lbs. of lead-wool. The total number of feet of pipe laid was 69,553, at an average cost of $7.09 per foot.

After the main was finished, and gas at 5 lbs. pressure put into it, everyone connected with the work waited with expectancy for complaints of leaking joints. Past experience had been that within a short time after laying a main these complaints started, and it was with incredulity, and finally with amazement, that it was seen that the main was holding tight—at least, according to all external appearances. One break developed; but beyond this no other trouble was reported, and, unbelievable as it may seem, none had been experienced up to November, 1914, the time of the writing of the paper. Several stretches of the line have been exposed as the result of other main-laying operations. In all about 150 joints have been uncovered at different points, and they are without a fault. While it may be too soon for congratulations in regard to the line, the author says this seems at least to be an indication that the work was well done, and that the material used was of the highest quality obtainable.

The following are some results of the pneumatic caulking of lead-wool or smaller-sized pipes than the 36-inch one previously dealt with: On 443 joints of 12-inch main the total cost per joint was $1.76, divided into 27 c. for labour and $1.49 for material; on 1922 joints of 16-inch main the total cost per joint was $2.31, being 32 c. for labour and $1.99 for material; on 400 joints of 24-inch main the total cost per joint was $4.37, being 78 c. for labour and $3.59 for material. As a means for determining the time consumed in yarning and caulking joints of these sizes of mains, and also for finding out the weight of lead-wool and yarn used, 100 joints were averaged; the results being as follows:

Size.	Time of Yarning.	Time of Caulking.	Weight of Lead-Wool.	Weight of Yarn.
12-inch	25 min.	27 min.	16·5 lbs.	1·6 lbs.
16 ,,	10 ,,	21 ,,	23·4 ,,	2·5 ,,
24 ,,	22 ,,	33 ,,	42·7 ,,	6·3 ,,

ARTIFICIAL ILLUMINATION IN RELATION TO ARCHITECTURAL EFFECTS.

In a lecture on this subject before the Society of Architects last Thursday, Mr. S. D. Chalmers, the head of the Department of Technical Optics, Northampton Institute, pleaded for greater consideration on the part of architects in the direction of adapting the architectural and decorative features of buildings to suit the illumination which will be required.

Some types of decoration, the lecturer said, are quite unsuitable for artificial illumination, and should be avoided in rooms which are intended to be used almost exclusively in artificial light. Other types of decoration are suitable for either artificial illuminants or daylight; but the differences between the characteristics of daylight and artificial illumination are such that one cannot assume that good results will be obtained by artificial light even though the results by daylight are most satisfactory. Variations in natural lighting had frequently led to important architectural developments, and these results indicated similarly successful treatment with artificial lighting. Whereas with natural illumination it was comparatively difficult to vary the distribution, the very opposite obtained with artificial lighting. The ideal of most illuminating engineers seemed to be to produce even and soft illumination throughout the room. But he was not altogether in agreement with this; for in many cases a more one-sided lighting with subsidiary cross or reverse lighting might be usefully employed. In using this method, however, one must not attempt to too closely imitate the conditions of daylight. The variations must be considerably less than those of daylight, because the actual illumination would usually be considerably below that which prevailed with daylight, and at this lower illumination the variation was much more readily appreciated.

A general description was given of various forms of artificial lighting and diffusing screens or reflectors. Mr. Chalmers, however, was not altogether favourably impressed, except for certain special purposes, with indirect lighting; his opinion being that this method gives a poor imitation of daylight, suggesting coldness and wintryness. It was probably on this account that many people preferred the semi-indirect system of lighting; for in this case the impression of artificial lighting was obtained, and the comparison with daylight did not obtrude itself. Similarly there had been several cases in London of completely concealed lighting in which the effect had not been happy.

In the course of a short discussion,

Mr. James Darch said this matter had not received the consideration of architects which it deserved, and there were a great many failures in interior architectural lighting effects. Architects were too much governed by the engineer. The latter might be a clever person and perhaps essential to the lighting of buildings, but he had failed on questions of art several times. Illumination was an art and not a science. The engineer produced the gas or electricity and brought it to the house; but when it came to the distribution of it, he did not think it was the duty of the engineer at all, but that of the architect.

Mr. Leon Gaster reminded architects that we now live in an age of specialization, and that they could not expect to themselves carry out all the details in a building. Lighting was one of these. He looked forward to the day when architects would adopt a different plan to that now generally the case—viz., of adding a rough percentage to the cost of the building for lighting, and perhaps being subsequently compelled to reduce the amount owing to extra expenditure in other directions. Illumination was now as essential a part of a building as ventilation or heating; and for this reason it was becoming more and more necessary to call in the aid of the illuminating engineer.

Mr. Percy Tubbs suggested that illuminating engineers should provide tables giving architects the values of different illuminants at varying distances.

Mr. J. S. Dow also urged that engineers and architects must work together.

Mr. Chalmers, in briefly replying, said he thought it was the architect's business to say what amount of lighting he wanted, and where he wanted it; leaving the illuminating engineer to distribute it. Hitherto the architect had not told the illuminating engineer what he wanted; and this had been the cause of many failures. As to the effects to be aimed at, he thought it was better to give the impression of good artificial lighting rather than weak daylight. In reply to Mr. Tubbs, he said that most lamp makers now supplied detailed information of the character to which he referred, together with polar curves.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

The "B.C.G.A." Munitions Advertisement.

SIR,—We always welcome the fullest criticism. That directed in this week's "JOURNAL" against the recent full-page advertisement in the "Daily Mail" is particularly interesting, because it provides us with an experience with which we are becoming familiar, as it occurs almost as often as we issue some very striking advertisement.

This experience is to be told on the one hand that the advertisement is all wrong, and on the other hand that it is the most effective we have ever published. This is exactly what has occurred in this instance; for one of the shrewdest men in the gas industry has taken the trouble to write and congratulate us particularly on the advertisement in question.

It is somewhat curious that the writer of the "JOURNAL" criticism should base his distinction between this advertisement, which he condemns, and others which have met with his approval, on the fact that the word "gas" does not at once hit the reader in the eye, because the subordination of the gas interest to the popular interest has been throughout the basic principle of all the "B.C.G.A." advertisements. These have never been obviously gas advertisements, so that the casual glance told the reader what he was asked to buy. They have always presented, first and foremost, the subject in which the public is interested—hot water at any time of day or night, cleanliness, coolness and convenience in cooking, economy in lighting, warmth in the home, &c., &c.—and have depended for their value on first attracting the favourable attention of the reader and then leading him or her to find out how it is proposed to supply that which the reader is conscious of desiring.

No one but a gas man could possibly imagine that the word "gas" could at the present moment attract the favourable attention of the reader one-tenth as well as the burning question of "munitions."

There will, of course, always be differing views on the value of any particular advertisement. But the proof of its value is, after all, the result accruing; and I can most emphatically state that no advertisement yet issued by the Association has produced a more satisfactory crop of promising inquiries from important business houses than the one singled out for "JOURNAL" criticism. I am sure you will be glad to have this very satisfactory proof of the fact that it was the criticism and not the advertisement that failed to hit the bull's eye.

On your critic's point, that "the gas industry is doing an immense amount of work in connection with the war, and the public are absolutely ignorant of it," I can only say that the writer cannot be well served by his press-cutting agency, as we possess voluminous proof (which would be gladly put at your service) that a great deal has been done to inform the public of the service which the gas industry has been rendering to the country during the war.

W. M. MASON, Secretary,
British Commercial Gas Association.

47, *Victoria Street, S.W., April* 16, 1915.

[We thank Mr. Mason for his comments on the criticisms we made last week not on the opportuneness of the munitions advertisement in the "Daily Mail," but on its character. One of the shrewdest men in the gas industry, we learn from our correspondent, has written to congratulate the British Commercial Gas Association particularly on this advertisement. This isolated correspondent and Mr. Mason will be interested to learn that other shrewd men in the industry with whom we have come in contact had not, until our criticism appeared, seen the advertisement, or, if they had done so, they did not know that it emanated from the Association, or had anything to do with gas. Our suggestion would have saved the Association this ignorance on the part of certain of their supporters as to their activity in connection with munitions, while not injuring, but in our opinion and that of others improving, the mission of the advertisement. Mr. Mason says it is somewhat curious that the writer of the criticism should base his distinction between this advertisement which he condemns and others which have met with his approval on the fact that the word "gas" does not "hit the reader in the eye," because the subordination of the gas interest to the popular interest has been throughout the basic principle of the British Commercial Gas Association advertisements. Surely the Association have not become so wedded to this "basic principle" that on occasion they cannot see that the happy combination of the two "interests" might be a distinct advantage. Everybody knows that munitions are required, and urgently so in increasing quantities; and "popular interest" might have been very much stimulated in the advertisement by being "hit in the eye" with the fact that the gas industry can offer a helping hand by supplying the means for accelerating production. Our correspondent does himself an injustice by deliberately avoiding our main suggestion. Nowhere in last week's comment did we suggest (as Mr. Mason would lead his readers to think we did) that the word "gas" standing alone would attract attention. What we did suggest was that the public, being already aware that munitions were required at faster rate, would be attracted by some such words, set in bold type, as: "Gas-Furnaces and Rapid Production of Munitions." There we have the "burning question" of munitions brought out as well as what we contend is a point of "popular interest"—that gas-furnaces promote their rapid production. This is better than having to read down the small type of an imaginary telephonic conversation to glean the information. We also learn that no advertisement yet issued by the Association has produced a "more satisfactory" crop of promising inquiries from important business houses than this munitions one. This statement standing alone is no real measure of success. It places upon the other advertisements a standard of success which may or may not be justified. Other advertisements have evidently produced an equally satisfactory crop of inquiries. This we quite believe. But in our correspondent's bare assertion there is no proof (Mr. Mason would have made a bad lawyer if he regards what he says as "satisfactory" proof) that the crop would not have been larger still if the advertisement had had a double-barrelled attraction in its heavy capital lines. As to the final remark in the letter—that a great deal has been done to inform the public of the service which the gas industry has been rendering to the country during the war—we still assert, from a fairly wide personal experience, that there is an enormous number of people who are still unaware of the facts; and this is why no valuable opportunity should be lost to keep the gas industry to the front when it can be done without detriment to anything more than a "basic principle" which is not universally applied, and the observance of which may not always be the best policy.—ED. J.G.L.]

Tar and Pitch Prices.

SIR,—With reference to your article, *re* tar and pitch prices (as affected by present war conditions), of the 16th ult., and your list of tar and pitch prices from Aug. 17, 1914, to March 22 this year, published in the "JOURNAL" for March 30, might I ask you to make it clear whether the shipping of pitch is resumed at the Humber, Norfolk, and Suffolk ports, because the contractor with whom we made a temporary agreement to accept £1 per ton (for the liquid products) until shipments of pitch are resumed, and then to pay us the price for the value of the pitch which has been obtained during the closed period (as per the "JOURNAL" of Sept. 22 and 29, 1914), at the rate of 12½ cwt. to the ton of tar, distinctly states that no pitch has been shipped since September, nor can be at the present time at these ports.

April 14, 1915. ENGINEER AND MANAGER.

[Referring to the above letter, it may be stated that the "Current Sales" reporter responsible for the table of "Tar and Pitch Prices" given in the "JOURNAL" for March 30 (p. 792) writes that, so far as he is aware, no pitch has been shipped from the Humber, Norfolk, or Suffolk ports since the commencement of the war, nor is it possible to do so now. He adds: "Pitch from the Humber ports has always been taken by regular liners; but the liners are too full of Government traffic to think of carrying pitch, and it is impossible to secure other tonnage. With regard to the Norfolk and Suffolk ports, this business has always been difficult to arrange, owing to the trouble of securing boats; and now that there are two freights for every one bottom, the matter is impossible."—ED. J.G.L.]

REGISTER OF PATENTS.

Charging Gas-Retorts.

DRAKES LIMITED, and DRAKE, J. W., of Ovenden, Halifax.

No. 8091; March 31, 1914.

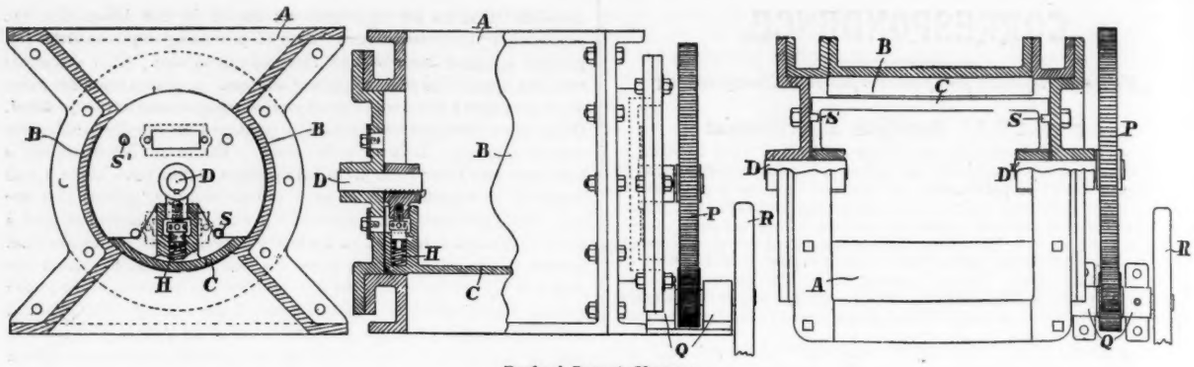
This invention relates to apparatus so constructed that the process of charging the retorts may be carried out without escape of gas; while adjustments can be made to compensate from time to time for any wear or other deterioration, and facilities be afforded for actuating the devices in varied positions.

The illustration on next page shows a sectional end elevation, an elevation (half of which is in section), and a plan (half in section) of the parts shown in the other two views.

A shoot or hopper A is placed above a cylindrical structure B, within which is mounted a rotary valve C conforming in shape with the inner circular walls of the cylindrical structure. The valve has pivotal shafts D D^1 at each end mounted concentric with the cylinder. The bearing surfaces of the valve conform to, and fit upon, surfaces formed at or towards the ends of the cylinder, and longitudinal strips fit closely against the faces of the cylinder throughout their lengths. Thus gas-tight joints are formed between the valve C and cylinder B. The valve C is mounted upon sleeves fixed upon the inner ends of the shafts, and the projecting parts of the sleeves are connected to, or fit within, projections formed on, or extending from, the ends of the valve by adjusting screws (one at each end) in order that, as the screws are rotated in one direction or the other, they advance towards the shafts or move outwardly from them.

The extending ends of the screws slide within openings made to receive them in the arms of the valve C, so that within an extension of the cavity in which the parts take springs H may be mounted. Thus when the screws are rotated into the openings in the arms the springs are compressed and the valve C is thereby forced, with an increased pressure, to press its surfaces more firmly against the surfaces of the cylinder. Therefore any wear incident to the rotating of the valve within its cylindrical structure is compensated for by the actions of the screws.

On the outer end of the shaft D^1 is fixed a spur wheel P, so that it may be engaged with by a pinion carried in bearings Q in such manner that its shaft may have the hand wheel R fixed upon it. By this wheel,



Drakes' Retort-Charger.

motion may be transmitted to the valve C, so that it may be adjusted to cover the opening through the lower part of B, or the valve may be rotated to uncover the opening.

Instead of the hand wheel being used for moving the valve C, there may be a chain wheel for transmitting motion thereto; while in order to arrest the valve in its proper position, stop pins S S¹ are fixed. Thus the valve may be moved from the position indicated in the end elevation (where it covers the outlet opening from the cylindrical structure) until it is arrested by the stop pin S¹, where it will have entirely uncovered the outlet opening from the cylindrical structure. Thus the operative is enabled, easily and without uncertainty, to adjust the valve in its proper open and closed positions.

Vertical Gas-Retorts.

GLASGOW, A. G.; a communication from J. H. TAUSSIG, of Philadelphia, U.S.A.

No. 8829; April 7, 1914.

This invention has reference to "base-closing means" for vertical gas-retorts, whereby the charges in the retorts can be supported "in such manner as not to interfere with the gas being led off through openings in the walls just above doors which seal the bottoms of the retorts, and the gas pressure above the doors thus rendered insufficient to cause leakage."

The base-closing means proposed comprise a door-frame having a number of door-openings, aligned gas-ducts opening through the walls of the openings, doors adapted to seal the openings below the ducts, and charge-supporting covers above the ducts and adapted to permit of the passage of gas. Each door has two parts, with a space between them, "which is accessible in the sense that gas can enter it from the interior of the lower part of the retort, of which door one part operates as a seal and the other part as a charge-support." The aligned gas-ducts are formed in the door frames, and through them the spaces between the two parts of the several doors are in communication with a gas off-take.

Fig. 1 is an elevation (partly in section) of such a set of retorts. Fig. 2 (drawn to an enlarged scale) illustrates some details of construction. Fig. 3 is a sectional view at right angles to fig. 2. Fig. 4 is a bottom plan view.

A is the "accessible gas space" referred to; B is the charge supporting cover; and C operates as a seal. Each door frame D is provided with gas-ducts E communicating with the space A, and aligned so that they can be cleaned as by a tool inserted at F. G is an off-take pipe communicating with the gas-ducts and with a hydraulic seal H, from which gas is drawn by an exhauster I into a storage holder. The parts B C are united at J, toward one side of the door—preferably that about which the door turns, and at the opposite side these parts are connected by a support K.

The area of the part C exceeds the area of B, so that gas can enter the space A from the interior of the lower part of the vertical retort L, while the retort charge is supported above it. The bottom closure is supported by a pivoted cotter bar detachably clamped at M. N are gas outlet connections at the tops of the retorts.

Temperature Regulating Apparatus.

GLOVER, T., of Angel Road, Edmonton.

No. 9480; April 16, 1914.

This apparatus is for regulating temperatures by determining the flow of gas to burners, and is of the kind "wherein a pair of members having different co-efficients of expansion, and which, when exposed to the influence of the temperatures, expand at different rates and have action upon a series of levers having combined pivot and knife-edge bearings to open or close a valve having V or other shaped openings and acting against a tube or a flat valve acting against an adjustable tube to determine the flow of gas to the burners." The patentee's object is "to construct such an apparatus in an improved and particular manner characterized in that all the levers are supported on, and have action on, knife-edges, and are assembled together and carried by a plate which can be secured in the usual gas-tight box."

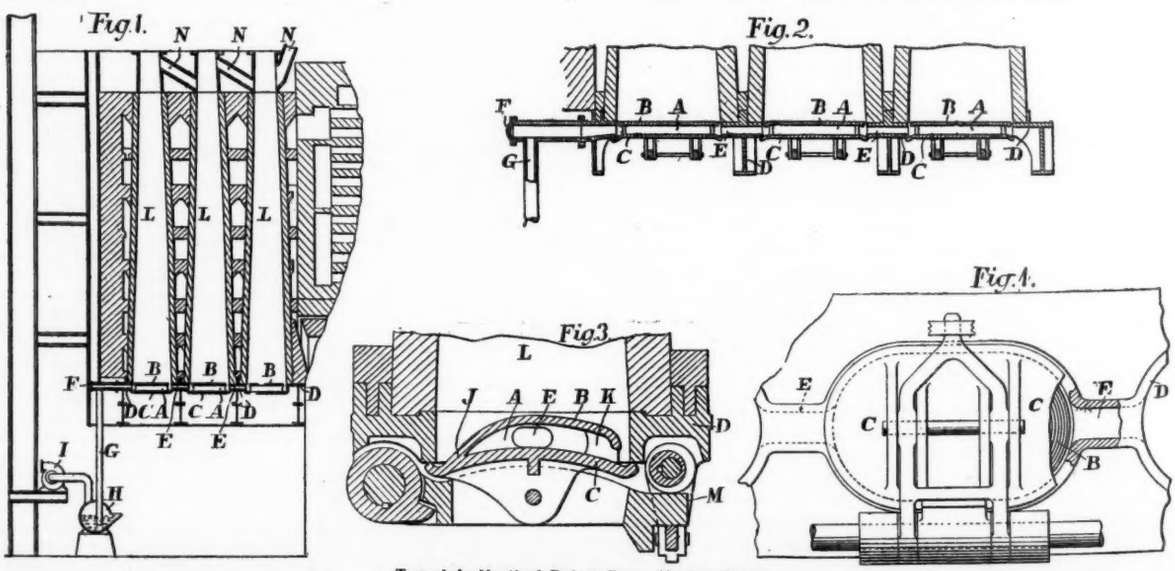
A plan view, a side elevation of the apparatus with one of the side plates or cover removed, and a detail of the valve and valve casing are given on p. 153.

A gas-tight casing is employed having an inlet A connected with the gas supply and an outlet B connected with the burners, and from one side of this casing, and at right angles thereto, projects a tube C having an opening into the casing, and being preferably provided with a screw-thread near its connection with the casing for ready application to a device in which the heat is to be made constant. The ends of a plate D depend and carry knife edges E F, against each of which a beam has action—one beam G being provided with a knife edge H at one end, and on which the other beam I rests near one end. The plate D is secured to the roof of the casing as shown.

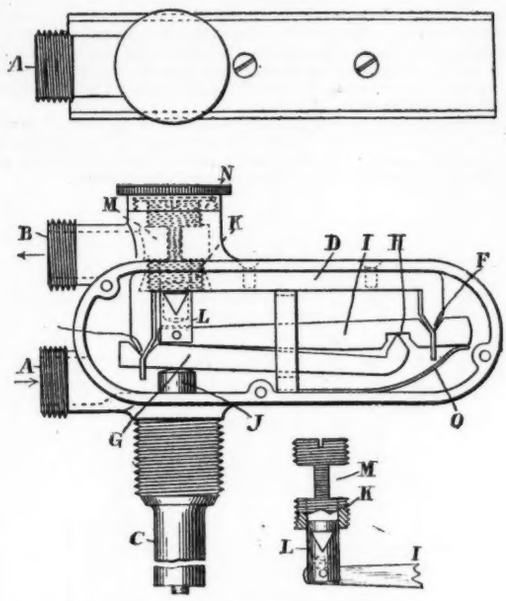
Inside the tube C is a rod J of dissimilar material to that of the tube. It projects inside the casing and on it rests the beam G, the upper edge at one end resting on the knife edge E, while the other end (which has the knife edge H) is positioned on the opposite side of the rod J. On the knife edge H rests the other beam I, held against the other depending knife edge F; the other end of the beam being positioned below a valve casing K in axial line with the tube C and carrying the valve L.

Guide plates are employed straddling the beams, which are one above the other so as to ensure their straight up-and-down motion, and guide loops also depend on each side of the depending knife edges, for the same purpose and to keep the beams in proper position.

The valve L is of cup-form, and has three triangular holes in its



Taussig's Vertical Retort Base-Closing Means.



Glover's Temperature Regulating Apparatus.

side. It slides within the valve casing K, which has a plain bottom part and holes or openings M at the top part leading to the outlet B. An opening N is made in the casing in axial line with the tube C and valve L, so that the valve and its casing can be readily got at—being closable by a plug or cap to keep it gas tight. A spring O may be employed to normally keep the valve L open.

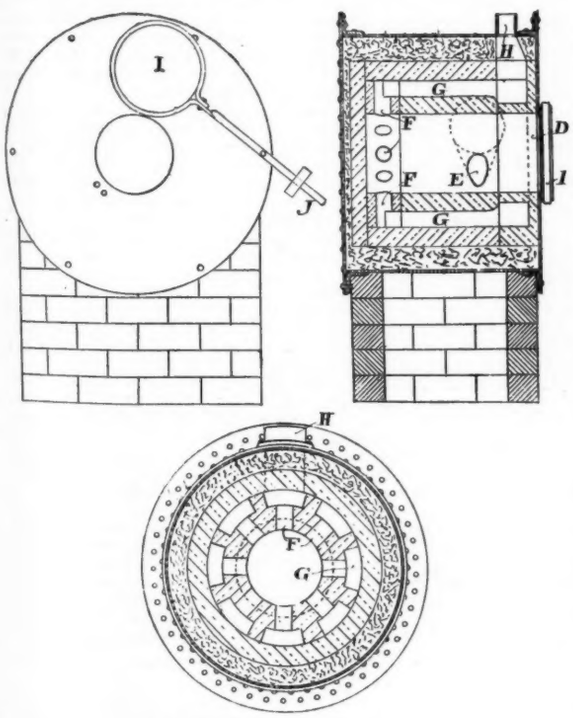
In action, and when the rod J lengthens (due to the temperature), it acts upon the lower beam G, and the depending knife edge E acting as a fulcrum, the rod J, in moving, will lift the lower beam, and, by the knife edge H acting on the other beam I, will lift it. The other depending knife edge F acting as a fulcrum for the beam, the valve end will be moved to a greater extent, and the valve L positioned in the valve casing will determine the size of the holes in the valve, and so regulate the supply of gas which passes through them to the outlet B.

Furnaces Heated by Gaseous or Liquid Fuel.

TOOTH, L. F., of the Commercial Gas Company, Stepney.

No. 8961 ; April 9, 1914.

This invention relates to an improved construction of horizontal furnace applicable as a "Glory Hole" for glass-working, or for bar



Tooth's Gas-Heated Furnaces.

or tube heating, pipe enamelling, and other like purposes; being constructed on the lines of the crucible or melting-pot furnaces described in patent No. 8474 of 1913.

A front view of the furnace and longitudinal and transverse sections of it are given.

The furnace comprises a horizontal tubular structure closed at one end, and formed with a central firing chamber. Near the open end D, the furnace is provided with openings E to accommodate the burners, which are preferably tangentially arranged with respect to the firing chamber. Near the closed end of the furnace, outlets F are formed in the wall of the firing chamber and communicating with a number of horizontal flues G, which run longitudinally of the furnace and terminate in an annular chamber or ring surrounding the firing chamber near the open end of the furnace. This annular chamber communicates directly with the chimney by an outlet H. The open end of the furnace is closeable by a door I carried by a counterweighted lever J, by means of which the door can be readily swung aside when desired.

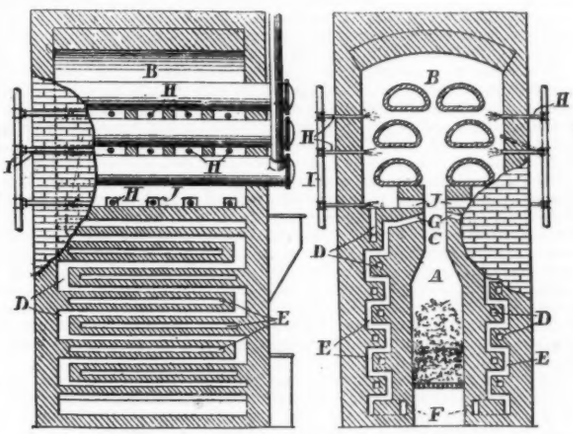
When in use the flames from the burners whirl around the firing chamber towards the outlets F; and the products of combustion pass along the flues G towards the front of the furnace, and thence to the outlet H. By the arrangement described a high regenerative effect and a more efficient heating are said to be obtained.

Controlling Combustion in Retort-Chambers.

GLASGOW, A. G.; a communication from J. M. RUSBY, of Philadelphia, U.S.A.

No. 12,257; May 18, 1914.

This invention has for its object "to control the temperature effect of the combustion in such a way that intense local heating may be avoided, and the heating effect properly distributed throughout the retorts." Generally stated, it consists in burning the combustible in the chamber in contact with the retorts, and controlling the temperature distribution by mixing the burning mass in the chamber—that is to say, "in stirring, circulating, or agitating it by means of jets issuing into the chamber from opposite sides and at various heights across the travel of the combustible fluid, so as to commingle the fluid combustible and air with hot and newly-formed products of combustion before the escape of these products from the chamber."



Rusby's Controller of Combustion in Retort-Chambers.

A longitudinal section (partly in elevation) of a coal-gas retort-bench, and a traverse section (also partly in elevation) are shown.

Producer gas from the chamber A reaches the chamber B by way of the passage C; while products of combustion escape from the chamber B through the flues D, and reach the stack (not shown). Air is heated in passing through the flues E, and is discharged in part at F, under the producing grate, and in part at G for the purpose of burning the producer gas in the chamber B, to heat the retorts. The flame formed by the combustion of the fuel gas with secondary air entering at G produces "a concentrated combustion and intense local heating effect," which "effect is undesirable in the case of a coal-gas retort-bench, since the result is to heat the retorts unevenly and to overheat that portion of the retorts which is in close proximity with the intense heating flame."

In accordance with the present invention, the burning combustible, as it is being consumed in a chamber which is at a very high temperature, is "stirred, circulated, agitated, or distributed" so that the formation of any intense local heating flame is prevented, and a proper distribution of combustion, and resulting heat, is attained by jets H extending through the walls of the chamber B, and discharging from opposite sides of the retort chamber, and "generally crosswise of, or at an inclination to, the direction of travel of the combustible fluid." These jets may be supplied, through connections I, with steam or other appropriate fluid—"for example, with a portion of the air necessary for combustion, or with a portion of the burning mixture itself, or with waste products of combustion suitably impelled through the jet appliance." Openings are shown at J, so that the lower jets may "operate effectively in stirring the burning fluid combustible, which is also stirred by the other jets."

Heating Coal-Gas Retort-Chambers.

GLASGOW, A. G.; a communication from J. M. RUSBY, of Philadelphia, U.S.A.

No. 22,425; Nov. 12, 1914.

Prefacing his specification the patentee remarks: "In the operation of coal-gas apparatus it has always been necessary to employ some

device for controlling the temperature of the solid fuel burning producers which serve for the heating of the apparatus. This temperature control is necessary because of the presence of ash in the solid fuel, and because of the tendency of the ash to fuse, at high temperature, and aggregate into masses of clinker, which cause serious trouble. Also, temperature control is necessary in order to avoid injury to the brick or other refractory material of which the producer is constructed.

"It has long been common art to pass steam through the producer fuel bed for the purpose of lowering the temperature of it, and thus avoid the foregoing high temperature troubles. This steam, in its passage through the fuel bed, is wholly (or in part) decomposed into its chemical constituents, with simultaneous absorption of heat from the fuel bed. Steam is a very suitable material to use for the cooling of the fire, since the volume that is required to effect a given temperature reduction in the fire is comparatively small in respect to other agents that have been used or suggested for the purpose, and the steam can be easily supplied and passed through the fire.

"Furthermore, the types of apparatus recently introduced for coal-gas manufacture are of such large size, and subjected to such heavy pressures of weight of material, that the existence of high temperatures is more dangerous to the structural material than formerly; and it is now found necessary to obtain control of the temperatures not only in the producer fuel bed, but also in the retort chambers in which is consumed, for heating, the gas generated in the producers.

"It can be shown by accurate calculation that the steam which, as in the foregoing, has heretofore been used for the control of the producer fuel bed temperature also has an effect in lowering the temperature yielded by a final combustion of the producer gas in the retort-chamber; and consequently a sufficient lowering of the temperature in the retort-chamber could be attained by the passage of a sufficiently large quantity of steam through the producer bed. The following important facts, however, are to be observed: Steam is expensive, requiring the cost of fuel for its evaporation, and whatever steam is used is finally discharged to the atmosphere at the stack and wasted—thus causing a loss of the heat required for its evaporation, and also whatever sensible heat it contains above the temperature of evaporation. Also, it is desirable, in order to obtain the best quality of producer gas and the most thorough utilization of the steam supplied, to not reduce the temperature of the producer fuel bed below the point which will insure freedom from clinker and the prevention of destruction of the refractory material of the furnace.

"In respect to the tendency to form clinker, and consequently the temperature required, different fuels vary very greatly, as will also the ability of the materials of which the producer is constructed to withstand high temperature. For instance, with a fuel approximating to pure carbon, and with the best grade of material employed in the construction of the producer, both the fuel bed and the structural material would endure the maximum temperature attainable in combustion. Consequently no cooling of the fire, and no steam supply thereto, would be required; whereas under different fuel and structural material conditions, the required cooling of the fuel bed, and steam supply, will be great. It is an important fact, however, that such variation in the degree of cooling of the producer fuel bed will, unless combined supplementary method of control be provided, produce corresponding and injurious or dangerous variations in temperature of the retort-chamber and other parts of the apparatus; and to prevent injurious temperature variations, supplementary control must be provided."

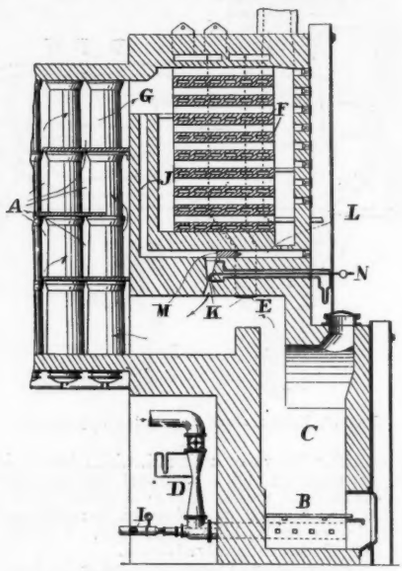
The present invention is said to be based on the discovery that the quantity of steam supplied through the producer fuel bed can be appropriate for the fuel employed and the character of the structural material of the producer, and need not exceed this quantity, and that the use of steam should be combined with a cheaper and more satisfactory method to separately and simultaneously control the temperature of the retort chamber to any extent whatever which may be required. The principal object aimed at therefore is to "more economically, more efficiently, and separately or independently" control the temperature of the fire so as to avoid the formation of clinkers and injury to the producer, and the temperature of the retort chamber so as to avoid undue local or excessive heating of the structural materials, and "to effect therein a uniform distribution of heat or regulation or control of temperature effect of secondary combustion or retort heating."

The invention comprises a process of heating coal-gas retort or coal carbonizing chambers which consists "in generating producer gas from fuel with air, burning the producer gas with secondary air in the retort-chamber, and separately controlling the fire and chamber temperatures by passing sufficient steam through the fire to keep its temperature below that which will cause the formation of clinkers or injure the producer, and by adding to the burning producer gas an appropriate incombustible diluent whereby only so much steam is passed through the fire as is required for the avoidance of clinkers, and whereby little or no power is required for the introduction of the incombustible diluent which may be products of combustion, while at the same time the bench is operated economically, efficiently, and uniformly."

An apparatus "in connection with which the process of the invention can be practised has been chosen from among other apparatus capable of the same use," and is illustrated principally in section.

A is the coal-gas retort-chamber and B is the grate upon which a burning fuel bed is supported. Producer gas is generated in C by the passage of air through the burning fuel bed. D is a metering device for introducing primary air beneath the grate. E is a means for introducing secondary air into the retort-chamber. It is connected with the recuperator F, so that the producer gas, in rising, meets the secondary air and is burned; the products of combustion passing through the retort-chamber to G, and then traversing the recuperator, finally reaching the chimney stack H. I is a steam-meter, having a regulatable connection for passing steam beneath the grate and through the burning fuel bed. Incombustible products of combustion may be taken from the exit of the retort-chamber and added to the burning products of combustion of the producer gas by way of the passage J and metering device K, or incombustible products of combustion may be taken after they leave the recuperator and are on their way to the chimney by way of the passage L of the metering device R. The position of the slide valve M determines from which source the incombustible products of combustion are taken for supplying the opening of the metering device K. A jet of steam, supplied through the pipe N, may be used in connection with the metering device K for delivering the incombustible products of combustion.

The metering devices D and K are preferably of the Venturi tube type, provided with manometer gauges for ascertaining the difference between the pressures at the inlets and throats of the tubes, from which the velocity of flow can be deduced in the usual manner.



Rusby's Retort-Chamber Heater.

Concluding his lengthy specification, the patentee says: "In the practice of the invention and for all practical purposes, the control of the retort chamber temperature and of the fire temperature are independent. Inasmuch as the incombustible diluent is added to the burning producer gas, it follows that the diluent does not pass through the fire, which is advantageous, because the resistance of the fuel bed is considerable, and it would require power to force the incombustible diluent through it. Furthermore, steam being under pressure can be inexpensively put through the fire, because its pressure, which is cheaply attained, is sufficient to overcome the resistance of the fuel bed. Moreover, only the steam necessary to avoid clinkers, or undue heating of the producer, may be used, and the rest of the temperature control be effected by means of the incombustible diluent, which may be products of combustion obtainable without cost and cheaply applied when introduced in the manner described at a point where they do not have to be forced past the resistance of the fuel bed. Furthermore any steam decomposed in the fire returns to steam when it meets the secondary air; so that all steam introduced is eventually lost up the stack, whereas the products of combustion returned above the fire are continually circulated and returned, and no heat is lost.

"By way of further explanation it may be said that with some fuels, the amount of steam required to avoid clinker would be insufficient for preventing damage to the brickwork by the secondary combustion. In such a case it is evident that an economy is effected by using only the amount of steam necessary for preventing clinker, and supplementing it with incombustible products of combustion introduced to the burning products of producer gas in order to regulate and control the temperature effects of the secondary combustion in respect to the safety of the brickwork of the retort chamber and of the retorts. The volume of steam practically required to be passed through a fire of fuel of ordinary good quality to avoid clinker is about 31 cubic feet per pound of carbon consumed, and its weight is about 1¼ lbs. Contrasted with this, the volume of combustion products that would have to be passed through a like fire for the same purpose is 78 cubic feet per pound of carbon consumed, and its weight would be over 6 lbs.

"Evidently if the steam through the fire were relied upon for both the fire and retort temperature control, the quantity of it required for the fire control might be wholly inappropriate for the retort temperature control. Furthermore, while it is desirable to use steam through the fire because it can, by reason of its pressure, be cheaply put through the fire, it is undesirable to use steam for the retort-chamber control, because all steam used is finally wasted by going up the stack. While products of combustion cost nothing, and are easily introduced to the burning producer gas, still it is expensive by reason of their great weight and volume to force them through the fire or fuel bed; whereas their introduction into the burning producer gas is not only easy but efficient and not wasteful of heat. At some times the quality of fuel may be so good that no steam or other cooling agent is necessary in order to avoid clinker; and in such cases the independent regulation of the temperature is particularly advantageous."

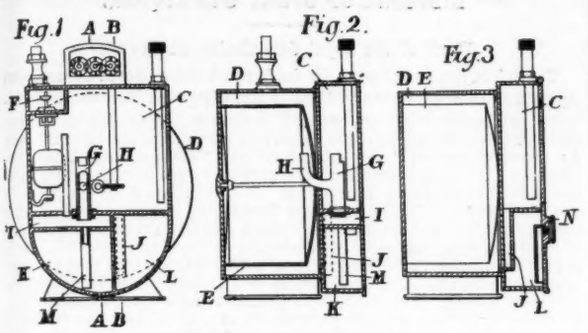
Gas-Meter.

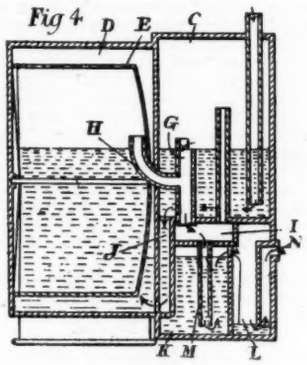
ROGERS, A., of Wellington, New Zealand.

No. 29,914; Dec. 29, 1914.

This invention relates to wet gas-meters, "in which an increase of the pressure of gas in the mains will not overcome the water-seal between the inlet chamber and the measuring chamber and allow gas

to pass the measuring drum without operating it." The sealed inlet chamber, having a passage from the bottom to an opening in the bottom of the measuring chamber, is combined with a water-seal compartment below the inlet chamber, and divided into two chambers—communication between them being by an orifice near the top.





Rogers' Gas-Meter.

Fig. 1 is a front sectional elevation; fig. 2, a cross sectional elevation on the line A; and fig. 3, a similar section on the line B. Fig. 4 is a diagrammatic sectional view to show the operation of the meter.

The meter comprises an inlet chamber C, measuring chamber D, measuring drum E, and float valve F, of the ordinary construction. The inlet chamber is divided from the measuring chamber by a vertical partition; while below the inlet chamber a water-seal compartment is divided from the inlet chamber by a horizontal partition, The entrance pipe G, located in the latter partition, has the usual bifurcated branch H projecting into the measuring drum, and made water-tight so that water cannot pass into the chamber D at this point. The lower end of the pipe G communicates with a chamber I upon the underside of the horizontal partition.

A passage J, from the partition of the inlet chamber (and communicating with the lower part of the measuring chamber), is the only communication the chamber has with the chamber D; so that water passing to the measuring chamber must travel through this passage only, since no water can pass into D through the branch H of the entrance pipe owing to the top of the branch being above the water level, the height of which is governed by the height of the pipe G.

The space below the horizontal partition is divided into chambers K L by a vertical partition; and into the former chamber a pipe M depends downwardly a desired distance from the chamber I. An orifice at the top of K makes communication between the two chambers K L. From near the bottom of the chamber a passage extends upward a desired distance, and leads to the overflow N in the cover of the front of the meter; while the lower end of the passage forms a water-seal.

When water is poured into the inlet chamber C, it flows through the passage J into the measuring chamber D (as indicated by the arrows), and fills both chambers to the level shown in fig. 4. As the water is continued to be poured in, it overflows into the pipe G, and flows into the chamber I; then through the pipe M into the chamber K, filling it to the height of the orifice in it, through which it flows into the chamber L, and out through the overflow N.

As the gas comes into the inlet chamber C it immediately passes into the measuring drum E and establishes the same pressure upon the surface of the water within the drum and the chamber, The gas cannot pass into the measuring chamber otherwise than through the pipe G and drum E, as already explained. It will therefore be seen that there is a large head of water between the water level in C and the bottom of the passage J and an equally large head of water between the bottom of this passage and the level of the water in the chamber D. This head of water will be such as to resist the gas pressure that will be introduced into C. Further, since the water forming the seal between the inlet chamber and the measuring chamber has no communication with the overflow pipe it cannot be forced out by any increase of gas pressure.

Tar for Roads in War Time.—The Okehampton Rural District Council had laid before them at their last meeting a letter which has been received from the Local Government Board stating that a request had been made by the High Explosives Department of the War Office that nothing but dehydrated or refined tar should be used for road improvement works at the present time, in view of the fact that crude tar contained certain bye-products which were required by the Government for manufacturing high explosives.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills: The Ilfracombe Gas Bill has been read the third time and passed. The opposition to the Altrincham Gas, Ormskirk Gas and Electricity, and Warwick Gas Bills has been withdrawn.

The Ashington District Council Bill and the Plymouth Corporation Bill have been referred to a Select Committee, consisting of the Marquis of Bath (Chairman), the Earl of Harrowby, Earl Cathcart, Lord Ravensworth, and Lord D'Aberon; to meet on Thursday.

HOUSE OF COMMONS.

Government Charge for the Use of Interned Ships.

Mr. Ronald M'Neill has given notice of his intention to ask the Prime Minister to-night "whether his attention has been called to a circular recently issued by the Chairman of the South Metropolitan Gas Company, in which complaint is made that, whereas the Government pay from 3s. 6d. to 4s. per ton for steamships requisitioned for Government use, they charge no less than 10s. per ton to traders for the use of interned enemy ships, thus setting a bad example to shipowners, which tends to keep up the price of freights, and consequently the price of coal to the consumers; if he will say who is responsible for fixing the prices for the use of interned enemy ships; and why the prices are fixed at a higher rate than those paid by the Government for the use of commercial vessels requisitioned for His Majesty's service."

Dyes from Herbs.

At the sitting of the House last Thursday, Mr. King asked the Parliamentary Secretary to the Board of Agriculture (Sir Harry Verney, Bart.) whether the Board were aware that many herbs, trees, and mosses are the bases of excellent dyes, and that these vegetable dyes produce fast colours superior to any aniline or other chemical manufactures; and whether they had considered the possibility of collecting these dye materials throughout the country, with a view to their being turned, by treatment at some central works, into dyes capable of use in the textile industries. Sir Harry Verney said he was advised that none of the plants capable of producing a substitute for aniline dyes could be profitably cultivated in this country. Mr. King asked whether some of them were not wild, and did not need any cultivation. Sir Harry Verney said they would need picking. Mr. King suggested that children and women, who might otherwise get into mischief, might be employed at remunerative rates to pick them. Sir Harry Verney said if his honourable friend would organize and lose money over the industry, the Board of Agriculture would watch the experiment with much interest.

The following further progress has been made with Bills: The Ammanford Urban District Council Bill has been reported from the Local Legislation Committee, with amendments; the Ascot District Gas and Electricity Bill has been read the third time and passed; the Ilfracombe Gas Bill has been brought from the Lords, read the first time, and referred to the Examiners.

The Down County Council have withdrawn their petition against the Lurgan Urban District Council Bill; and the Durham Corporation theirs against the Weardale and Consett Water Bill.

PRESCOT GAS BILL.

Although this Bill was included in a list of Bills, consideration of which was to be commenced last Thursday by a Committee under the chairmanship of the DUKE OF WELLINGTON, no parties appeared either in support or in opposition; and it was said in the Committee Room that the measure is to go forward unopposed.

NORTHWICH GAS BILL.

When a House of Lords Committee presided over by Lord HYLTON came to the consideration of this Bill last Thursday,

Mr. HONORATUS LLOYD, K.C., on behalf of the promoters, announced that the outstanding points in opposition had been settled, and that, subject to the Committee finding the preamble proved, the Bill was unopposed. Counsel added that the Bill originally sought to acquire a new site for the Company's gas-works, to extend the limits of supply, to substitute a calorific power test for the existing illuminating power test, to change the Company from a maximum dividend to the sliding-scale one, to convert the ordinary share capital into stock, and to raise £45,000 additional capital. Owing to objections which had been taken by the Northwich Council and also by certain owners of property in the neighbourhood, the proposal to acquire the new site for the gas-works had been withdrawn from the Bill. Another point conceded to the Council was the insertion of a purchase clause in the same terms as those granted to the Chelmsford Council last year. The Company had further abandoned the proposal to place itself under the sliding-scale. With regard to the calorific power test, the Model Bill clauses had been inserted in the Bill, with the exception that the Company preferred a real standard of 500 B.Th.U. without any margin, instead of 540 B.Th.U. with a 7½ per cent. margin. The Company held the view that the Model Bill standard served no really useful purpose.

The 500 B.Th.U. standard had already been granted this session in the cases of Ilfracombe and Spennymoor.

The preamble of the Bill having been formally proved, it was ordered to be reported for third reading.

On Friday, when it was arranged to take clauses,

Mr. LEES (the Parliamentary Agent) informed the Committee that the drafting amendments due to the deletion of the sliding-scale clauses were so numerous that he had not been able to complete them. It was decided, therefore, to deal with the clauses yesterday (Monday).

SUTTON AND DISTRICT WATER BILL.

A Committee of the House of Lords presided over by the DUKE OF WELLINGTON dealt with this Bill last Thursday.

The promoters were represented by Mr. J. D. FITZGERALD, K.C., Mr. HONORATUS LLOYD, K.C., Mr. BARNARD LAILEY, K C., and Mr. MOON. The only opponent, the Metropolitan Water Board, was represented by Mr. TALBOT, K.C., and the Hon. EVAN CHARTERIS.

Mr. FITZGERALD, after intimating that he intended to ask the Committee to refuse the Metropolitan Water Board *locus* against the Bill, stated that the object of it was purely domestic and of a financial character. Originally the Bill proposed to authorize the Company to raise £250,000 of additional capital; but certain works had been abandoned, and the capital powers had been reduced to £180,000. Having regard to the fact that this was the sole object of the Bill, he was astonished that the Metropolitan Water Board should have troubled to oppose it, and especially that the Board should have thought fit to raise matters in their petition which had nothing at all to do with the Bill, and which were, in fact, quite outside its scope. The main point of the opposition related to supply in Morden. When the Metropolitan Water Board's Act was passed in 1902, an agreed clause was inserted whereby the Board took over certain powers of the old Lambeth Water-Works Company to supply in a part of Morden, leaving the Sutton Water Company to continue to supply in the remainder of the district; and there was an agreement that neither party should supply water in the other's portion of Morden without consent. This was his reading of the clause in question; but now the Water Board desired to have the clause redrafted, on the ground that there had been a misunderstanding in 1902, and that what was intended was that the Board should have power to supply water in the whole of Morden. Probably the real object of the proposal was to bring Morden, which had now been formed into an urban district with Merton, into the position where this district could be levied with a portion of the deficiency rate which the Board had now to make in their district. At present, however, the Board could not levy the deficiency rate upon any district unless they were supplying in the whole of the area, which, in the case of Merton and Morden, they were not now doing. If the Water Board were not satisfied with the Company's construction of the clause regarding the supply in Morden, their obvious remedy was to go to the Courts and have the point decided. An even more astonishing proposal in the petition was that there should be a clause inserted in the Bill providing that, in the event of the Water Board purchasing the Sutton Water Company, no account should be taken in the purchase price of the powers in the present Bill. He failed completely to understand why this should be asked.

Mr. TALBOT, on behalf of the Water Board, urged that there had been a misunderstanding in the drafting of the clause in the Board's 1902 Act relating to the supply in Morden, and contended that the Bill of the Company's was the proper method of putting it right. As to purchase, the Board were satisfied that the time was rapidly approaching when an extension of their water limits must be faced; and it was in view of this that it was asked that the powers of the present Bill should not be used to enhance the value of the Company's undertaking in the event of such purchase.

The Committee decided that the Water Board were not entitled to *ocus*.

The preamble of the Bill was then formally proved.

Leicester Corporation Gas Accounts.

From the analysis by Mr. Hubert Pooley (Engineer and Manager) of the accounts of the Leicester Corporation Gas-Works for the year 1914, it appears that the capital outstanding was £1,015,106, or at the rate of £5 8s. 6d. per ton of coal carbonized, and 9s. 2d. per 1000 cubic feet of gas sold. The quantity of coal carbonized was 170,713 tons, and of oil used (coal equivalent) 16,441 tons; the gas made totalling 2,317,129,000 cubic feet, or 12,381 feet per ton of coal carbonized. The sale per ton was 11,839 cubic feet; and the gas unaccounted for, 3·45 per cent. The sales of coke and sulphate per ton of coal carbonized (coal only) were: Coke, 10·16 cwt.; and sulphate of ammonia, 27·41 lbs. The net proceeds of residuals on the cost of coal equalled 54·81 per cent. The balance of net profit for the year was £9580, or 1s. 0·28d. per ton of coal carbonized, and 1·04d. per 1000 cubic feet of gas sold.

Birkenhead Gas and the Strike.—Complaints having been made by consumers as to the quality of the gas that is being supplied at Birkenhead, Mr. T. O. Paterson (the Gas Engineer) has addressed to the local Press a letter upon the subject, in which he says: "It is common knowledge throughout the town that a strike of three weeks' duration prevailed at the gas-works up to about a week ago. During the period of the strike, practically the whole of the large staff of men usually engaged in the manufacture and purification of gas were absent; and their places had to be filled with non-experienced men. Working under such conditions of labour, ordinary results could not be maintained; and a portion of the purifying plant became inefficient, and allowed sulphuretted hydrogen to escape into the holders. Pure gas has been manufactured since April 9; and it is hoped that very shortly all cause for complaint will be removed."

MISCELLANEOUS NEWS.

DISPOSAL OF SPENT GAS LIQUOR.

Views of the Royal Commission on Sewage.

There has just been issued the final report of the Royal Commission appointed in 1898, with the Earl of Iddesleigh as chairman, to "inquire and report what methods of treating and disposing of sewage (including any liquid from any factory or manufacturing process) may be properly applied." In this report the Commissioners briefly recapitulate the main conclusions at which they have arrived, as set forth in the nine reports they have issued. Four of these dealt mainly with the purification of domestic sewage discharging into streams, two with the discharge of sewage into tidal waters, and three with the discharge of manufacturing effluents. In their ninth report, the Commissioners deal (*inter alia*) with the discharge of trade wastes which could not be taken into sewers. For the purpose of suggesting standards for the different wastes, they have been grouped into two classes—viz., (1) those for which efficient purification is practicable; and (2) those for which, in the present state of knowledge, it is not practicable. In the latter group are included waste liquors resulting from gas and coke production, in regard to which the Commissioners say they are "not aware of any method of so treating them that the effluents could properly be discharged direct into the sewers." They are unable to suggest a limit of purification for gas liquor; but they say that in no circumstances should it be discharged untreated into a stream. In some cases purification by percolation through "bings" may be sufficient to permit the discharge of an effluent; but the Commissioners cannot make any general pronouncement on the point. Where no "bings" exist, biological treatment, on the lines suggested by Dr. Fowler (to which reference is made later), will, they say, "lessen very materially the polluting power of the liquor." The Commissioners remark that evaporation appears to be the only other practicable alternative at the present time.

With these introductory observations, we give the following extracts from the ninth report bearing directly on the subject just mentioned.

SPENT GAS LIQUOR.

Spent gas liquor is, of all trade wastes, probably the most difficult to deal with. It is produced in large volumes and in all parts of the country; but, fortunately, improved procedures in the distillation of coal are tending to materially lessen the quantity per ton of coal distilled for coke production, as time goes on.

By the term "spent gas liquor" we mean the brown coloured aqueous solution, smelling of tar, which is produced in the recovery of the ammonia from: (1) The manufacture of coal gas for lighting purposes; (2) the coking of coal; (3) the manufacture of producer gas for heating; (4) the waste gases of blast-furnaces; (5) the distillation of shale for oil. We confine our remarks here to the liquor from coal.

When coal is distilled or used for any one of the purposes just enumerated, a considerable quantity of water vapour—something like 18 per cent. by weight of the coal—among other things, is given off. This comes partly from the moisture in the coal itself, and is partly produced by the destructive distillation. Another volatile product is ammonia—a certain proportion of the complex nitrogen compounds of the coal being broken-down by the heat into this simpler substance. Being a most valuable bye-product, this ammonia has to be prevented from escaping into the atmosphere. In the most recent types of coal-distilling apparatus for coke production, this is effected without the aid of additional water, but in the majority of cases it is still done by passing the vapours from the oven (after first condensing as much of the tar as possible) through a water scrubber. The brown aqueous solution thus obtained is known as "ammonia liquor." This is in its turn distilled, some lime being added in the later stages of the distillation. The ammonia evolved is condensed in sulphuric acid to sulphate of ammonia; the residue in the still being "spent gas liquor" or "spent ammonia liquor." At some gas-works the ammonia liquor is distilled on the spot, but usually it is sold to chemical manufacturers, to be treated by them. The waste liquors amount to something like 100 to 120 gallons per ton of coal distilled—say, 50 to 55 per cent. by weight.*

Since all the condensed tarry matter from the distillation of coal is utilized in one way or another, gas liquor is the only liquid waste from this process. A very foul liquor, known as "devil water," is obtained by the condensation of the vapours escaping from the sulphuric acid in the saturator, after it has absorbed the ammonia distilled from the gas liquor. This is generally, we understand, returned to the storage-tank for gas liquor, and it ought certainly to be always returned, and never run off.

As already mentioned, the most modern types of plant for the coking of coal can be worked so as to produce only very small volumes of waste liquors. In ordinary practice, such plants yield much smaller amounts of waste liquors than those of the older type. Although there are comparatively few of such plants in use, we may expect them to increase, with a corresponding diminution in the amount of spent gas liquor. These new procedures may be briefly termed: The complete direct absorption process for the recovery of ammonia from coal distillation; and the partial direct absorption process.

In the complete direct absorption process the gases from the ovens are never allowed to cool below about 120° C.; consequently there is no condensation of aqueous vapour. The tarry compounds in the vapour are removed by scrubbing with hot tar oils, prior to the vapour passing through sulphuric acid in the saturator, for absorption of the ammonia. From the saturator the residual gases pass on direct to the coke-oven flues, to be burnt. The Otto-Hilgenstock process belongs

* There is obviously an error here. The figures quoted are too high. The quantity of liquor made per ton of coal may vary from a low figure up to (say) 45 gallons of 10-oz. strength, according to the class of coal used and the efficiency of the apparatus.—ED. J.G.L.

to this category. If the plant is working at its best, only 4½ gallons of waste liquor per ton of coal distilled are said to be produced.

On the other hand, the benzol and toluol in the vapour remain uncondensed, and are therefore lost, except for heating purposes. At first, difficulty was caused in the oil tar scrubber by the condensation in it of considerable quantities of chloride of ammonium. We understand, however, that this is now removed mechanically with the tar, and recovered from the latter. We are further informed that benzol and toluol are now almost invariably recovered in plants using the direct absorption process.

In the partial direct absorption process, the gases from the coal distillation are cooled to as low a temperature as possible—say, 15° to 25° C.; the water carrying the fixed ammonium salts and the tar being thus condensed, while the benzol and toluol are recovered by oil-scrubbing. After passing the scrubber, the gases are heated up again to about 70° C., prior to entering the sulphuric acid saturator, after which they are led to ovens to be burnt. The aqueous liquor holding the fixed ammonium salts must now be distilled with excess of lime in the usual way. The waste liquids in this case amount to about 25 to 30 per cent. of the coal coked. The Koppers' plant constitutes an example of this process.

To sum up shortly: It is possible to coke coal and to recover the ammonia without producing much waste liquor. If, however, benzol, &c., are to be recovered, then waste liquor amounting to 25 to 30 per cent. of the coal results, or it may be as low as 20 to 25 per cent. In the ordinary processes of making illuminating gas or of coking coal with recovery of the ammonia, waste liquor amounting to 50 to 55 per cent. by weight of the coal is produced. In the manufacture of producer gas, something like 10 gallons of waste liquor result from the carbonizing of 100 tons of coal in plants of the Mond type. In many gas-producer plants of this type dilute sulphuric acid is used instead of water in the scrubbers, until the resulting solution of sulphate of ammonia becomes sufficiently concentrated to allow of its evaporation.

Gasholder Water.

Water which has been used as a seal for the gas in gasholders is a very polluting liquid, which ought never to be allowed to escape to a stream.

Samples of Gas Liquor.

The analyses in the appended table of a few samples of the spent gas liquor, drawn at different types of works, will give some idea of its nature. The samples were as follows.

Sample No. 157 is the spent gas liquor from a coking plant which is settled in a series of three small tanks, and is then discharged, together with a large quantity of condenser water, into a river.

The gases from the producer plant at works No. 73 are not washed in the ordinary way with water, but are first air-cooled, then passed up a tower down which dilute sulphuric acid trickles, and then strongly cooled in another tower by means of a water-jacket. Two kinds of liquor are thus produced, both of the nature of spent gas liquor—viz., a strong liquor, formed by the condensation of water and other vapours in the cooling-tower (sample No. 190); and a weak liquor, produced by the evaporation of the sulphate of ammonia solution under diminished pressure, by means of a water-pump (sample No. 191). The two liquors are mixed together and discharged into a stream.

No. 06 is a sample of spent liquor from gas-works No. 74, and A and B are samples of spent liquor from gas-works No. 75—the second of these being an average sample.

If we consider the samples in the table, we find that, so far as the analyses go, they indicate that spent gas liquors, obtained by different processes and from different qualities of coal, vary greatly as regards strength. Such liquors are always very hard.

Laboratory Experiments.

Spent gas liquor being comparatively rich in phenol and other germicidal substances, it seemed advisable to make a few experiments in the laboratory, in order to gain some information as to the extent to which it inhibited bacterial oxidation when mixed with tap water and sewage. The experiments showed that the biological absorption of dissolved oxygen by highly diluted spent gas liquor (a liquor which is capable of taking up oxygen rapidly when it is oxidized by chemical means), even when the dilution is made with sewage, is decidedly slow. In other words, the inhibiting effect of the liquor on the biological purification of polluted water is great.

Other experiments on the absorption of dissolved oxygen from water were also made, using different volumetric methods for the determination of the oxygen. The details of these need not be given, as such volumetric methods are less applicable in the case of spent gas liquor than the direct measurement of the absorption in the Adeney oxygen-absorbing apparatus which was used. The general results were, however, the same; thus: When iron-works liquor was mixed with 1·5 to 6 times its volume of sewage, and the whole diluted about 100 times with tap water, the mixture took up dissolved oxygen fairly readily; and the results with steel-works liquor (No. 190) were confirmatory of the above. The absorption by the liquor when diluted with 99 volumes of tap water was negative, but comparatively rapid when twice its volume of sewage was added. The Commissioners have supplemented these preliminary trials by further laboratory experiments, extending from June 8 to July 20, 1914, on the biological filtration of sewage containing known percentages of spent gas liquor. [Tabulated results are given in the report.]

Biological Treatment, on a Large Scale, of Waste Gas Liquor admixed with Sewage.

At Oldbury, near Birmingham, great difficulty was found in purifying the sewage, on account of the admixture with it of about 7 to 8 per

Parts per 100,000.	No. 157. Colliery No. 71. Spent Gas Liquor: Partially Settled. Average of 5 Samples taken in Equal Quantities Every Hour.	No. 190. Steel-Works No. 73. Condensed Vapour from Producer Gas. Average of 24 Hours, in Equal Quantities Every Hour.	No. 191. Steel-Works No. 73. Exhaust Water from Ammonia Liquor Evaporation. Average of 24 Hours, in Equal Quantities Every Hour.	No. 06. Gas-Works No. 74. Spent Liquor from Sulphate of Ammonia Recovery Plant. Chance Sample.	No. A. Gas-Works No. 75. Spent Gas Liquor. Chance Sample.	No. B. Gas-Works No. 75. Spent Gas Liquor. Average Sample, taken every Half Hour on April 23, 1914, from 3 p.m. to 7 p.m., and on April 24, from 7 a.m. to 11 a.m.
Drawn	Dec. 16, 1909, 7.30–11.30 a.m.	Jan. 31, 1910, 12 noon, to Feb. 1, 1910, 11 a.m.	Jan. 31, 1910, 12 noon, to Feb. 1, 1910, 11 a.m.	May 19, 1910.	March 23, 1914.	April 23 and 24, 1914.
Analysis begun	Jan. 24, 1910.	June 13, 1910.	April 22, 1910.	May 23, 1910.	April 6, 1914.	April 30, 1914
Ammoniacal nitrogen	2·86	1·36	0·14	85·2	24·9	37·4
Albuminoid nitrogen	0·76	0·97	0·16	21·6	19·0	33·5
Total organic nitrogen	3·46	3·57	..	80·0	64·1	95·6
Nitrous nitrogen	..	..	..	..	..	..
Nitric nitrogen	0·07 (?)	..	..	..	..	..
Total nitrogen (Kjeldahl)	6·39	4·93	..	165·2	89·0	133·0
Oxygen absorbed from N/8 permanganate at 80° Fahr.:—						
At once	64·4	360·8	5·88	536·9	521·0	450
In four hours	172·5	583·6	12·25	729·9	697·0	558
Dissolved oxygen taken up from water at 65° Fahr.:—						
In three days	..	..	..	..	..	..
In five days	..	..	..	..	..	..
Chlorine	..	..	..	..	about 570	554
Solids in suspension	..	4·0 (4·0 V.)	1·20 (1·20 V.)	11·2 {6·1 V. 5·1 N.	182·8 {28·0 V. 154·8 N.	75·6 {21·6 V. 54·0 N.
Solids in solution	..	67·2 {51·4 V. 15·8 N.	73·4 {19·6 V. 53·8 N.	*1285 {507·1 V. 777·9 N.	2071·2 {424·0 V. 1647·2 N.	1903·4 {480·4 V. 1423·0 N.
Phenols	..	..	Only about 1 o/o of any	..	..	..
		(a) (b)	(a) (b)	(a) (b)		
Total sulphur	5·14	6·4 ..	5·86 5·78	.. 202·7	..	..
Sulphur present as—						
Sulphate (*i.e.*, expressed as S_2)	..	.. ..	.. ..	19·3 ..	..	..
Thiocyanate	..	0·0 ..	0·0 ..	112·0 109·0	112·0	107·4
Sulphide	..	.. ..	.. ..	1·0† 1·0	..	..
Thiosulphate	..	.. ..	.. ..	70·1 (by dif.)	..	..
Alkalinity (as H_2SO_4), using litmus paper	..	..	..	..	..	12·4
Remarks	Brown turbid liquid with only a rather small amount of fine brown suspended solids. Cresolic smell.	Clear yellow liquid with some black flocculent solids. Strong phenolic gassy smell. Acid to litmus.	Dark reddish brown but clear liquid, with a little black suspended matter. Strong gassy smell. The Gooch filtrate from the suspended solids was opalescent.	Very dark brown and turbid liquid, with a little black suspended matter. Strong phenolic smell. The Gooch filtrate was opalescent.	Dark reddish brown in colour, with dark green fluorescence.	Brownish-red with gas smell. Suspended solids grey and finely divided.

* These continued to lose weight rapidly on drying. † Probably no sulphide.

cent. of spent gas liquor from a chemical-works, though this waste liquor was run into the sewage uniformly. Mr. H. Silvester, and, subsequently, Professor Percy Frankland, were called in to advise upon the matter; and they carried out a number of experiments at the sewage-works, extending in all, for over a year.

A few analyses of the spent gas liquor in question gave the following average figures, among others :—

	Parts per 100,000.
Total nitrogen	56·8
Oxygen absorbed from permanganate at 80° Fahr. in 3 minutes	333·9
Oxygen absorbed from permanganate at 80° Fahr. in 4 hours	499·4
Sulphocyanide (CNS)	153·8
Sulphur as thiosulphate	46·8
Phenols	140·1

The sewage containing this waste liquor was first passed through a septic tank.

The general conclusion to be drawn from experiments was that sewage containing about 7 to 8 per cent. of spent gas liquor is capable of biological purification when treated in septic tanks and subsequently—at somewhat low rates—upon either contact beds or percolating filters. But even at so moderate a rate as one filling per day, triple contact filtration was found to be necessary for the production of a uniformly non-putrescent effluent.

The sewage at Oswaldtwistle, in the Ribble watershed, also contains an exceptional amount of spent gas liquor, derived from a gas-liquor distillery. The volume has not been accurately gauged; but we understand that it amounts to something like 3 per cent. of the total sewage flow. The sewage is treated in a series of septic tanks, and then on percolating filters. We are informed by Mr. Halliwell that the effluent produced is as a rule fairly good, though not of a high-class.

Partial Purification of Gas Liquor—Dr. Fowler's Process—Treatment of Waste Gas Liquor by Percolating Filtration after Preliminary Dilution with Water.

After experimenting with his colleagues, Messrs. Ardern and Lockett, in the laboratory of the Davyhulme Sewage-Works, Manchester, for a number of years, mainly upon the bacterial oxidation of thiocyanates and of phenol, and in conjunction with Mr. Hulton in an out-door experiment at the Manchester Gas-Works, Dr. G. J. Fowler was empowered by the authorities to make some large-scale experiments on the treatment of the Bradford spent gas liquor, upon already existing biological percolating filters at Frizinghall, Bradford. Previous to using the filters for this purpose, he re-inoculated them with an extract of soil, which had been covered with cow dung, and which quickly showed a strong development of nitrate. He informs us that the Bradford Corporation are now (1914) treating the whole of the waste liquor from the Corporation gas-works in this way, with a purification of over 80 per cent., as measured by the oxygen absorbed from permanganate in 3 minutes. After prolonged trial, he has come to the conclusion that it is better to allow a dilute (though relatively strong as compared with sewage) solution of the liquor to circulate again and again through the filter, rather than pass a very highly diluted liquor through once.

At Frizinghall, about 30,000 gallons of spent gas liquor are treated per day—*i. e.*, this volume of liquor flows in the course of the 24 hours to the small tank (capacity 26,560 gallons), where it is diluted with 9 to 19 times its volume of the gas-liquor filter effluent; this mixture being continuously pumped on to the filter. It follows that the continuous discharge of effluent from the filter to the sewers, per 24 hours, amounts likewise to about 30,000 gallons. At week-ends, by which time the liquid circulating through the filter has become too saline, the filters are dosed with clean water occasionally. Success in practice has been found to depend on beginning the filtration with a good dilution (say, 5 volumes of liquor in 100 volumes of effluent, *plus* water), and never allowing the feed liquor to get beyond a certain concentration, since it is antiseptic in its action.

The percolating filters (built of clinker of varying size, but covered with a layer, about a foot thick, of material from one-eighth inch to half-inch in diameter) have a total capacity of 5703 cube yards. Consequently, the volume of the crude undiluted liquor actually treated is about 5 gallons per cube yard per 24 hours. The composition of this liquor is approximately—

	Parts per 100,000.
Oxygen absorbed from permanganate in 3 minutes	448
Oxygen absorbed from permanganate in 4 hours	738
Ammoniacal nitrogen	27·7
Albuminoid nitrogen	18·5

Comparing the average diluted liquor fed on to the filters with the average final effluent discharged, Dr. Fowler finds the respective figures for oxygen absorbed from permanganate in 3 minutes to be 115 and 62. But since only about 30,000 gallons of final effluent are discharged per 24 hours,* the figure 62 must be compared with the 3 minutes figure of the original crude liquor—viz., 450—showing an approximate purification (as judged by this test) of over 80 per cent.

Disposal of Spent Gas Liquor by Evaporation.

In a few cases the spent gas liquor from coke-ovens or from power-gas plants is entirely evaporated, either by using it along with water for coke quenching, or by means of waste heat in specially constructed evaporators. When worked efficiently, both plans prevent the discharge of any spent gas liquor into streams, but result in local pollution of the atmosphere with vapours which cannot be said to be innocuous. In the evaporator plants some of the volatile organic constituents of the spent gas liquor are no doubt burnt; but in the quenching of coke there must be much less actual combustion, for in the latter case a volume of dense white steam is produced which may persist for some time in the atmosphere.

On the occasion of a visit by us to a colliery where coke was being quenched with a mixture of water and settled spent gas liquor, the steam had a strong phenolic smell. Since it is necessary to use an excess of water in quenching coke, special provision has to be made for collecting the drainage from the quenching floors, so that it may be pumped back again for re-use. So far as our information goes, only four special evaporators are at present in use in England and Scotland. Three are used in connection with the blast-furnaces at iron-works, the fourth is at a colliery where coke-ovens have been installed.

After describing systems of evaporators, the report proceeds: We may conclude our observations on this subject by pointing out the importance of constructing evaporator plants in duplicate, so as to allow of uninterrupted work in the event of a breakdown. Where no duplicate plant exists, either the profitable ammonia recovery plant must be stopped when the evaporator breaks down, or the spent gas liquor must be discharged. In some cases, waste gas liquor from collieries is discharged into old pit-workings.

Summary as Regards Spent Gas Liquor.

In view of the highly noxious character of waste gas liquor, we are of opinion that in no circumstances should it be allowed to be discharged untreated into a stream.

When it is produced at gas-works in a town, and does not at any time exceed 2 per cent. by volume of the sewage, it may, without serious detriment to the subsequent purification of the sewage, be allowed into the sewers, always provided that there is sufficient tank capacity at the gas-works where the gas liquor is produced to ensure that it shall flow into the sewers equably, and, as far as possible, continuously, and not in flushes. At certain sewage-works the biological efficiency of the tanks and filters has on occasion been seriously affected by an unexpected flush of this liquor. It must exert, of course, the same prejudicial effect upon the working of a sewage farm.

When the spent gas liquor, before being discharged to the sewers, is subjected to partial purification, a larger relative volume may be mixed with the sewage. We are not aware of any method of partial purification which is fairly successful, other than that suggested by Dr. Fowler; and this, we think, would probably prove more expensive than combined treatment of the gas liquor with sewage, where sewage was available.

As at most colleries there are large spoil-heaps, we recommend that these should be used for the purificatiou of the spent liquor by percolating filtration, as in the case of the "bings" at the shale oil-works in Mid and West Lothian. This may not in all cases result in a satisfactory effluent; but considerable purification will always be effected where large spoil-heaps exist. Where there are no spoil-heaps, we can only suggest, as an alternative at the present moment, the evaporation of the liquor. With the exception of the filtration of the waste liquor from shale distilling works through "bings" of spent shale, which must be regarded as a somewhat special case, we know of no method by which spent gas liquor can be purified at reasonable cost to such an extent as to render it innocuous if discharged into a stream. There are consequently no data to show what degree of purification might reasonably be asked for. Further work on the subject is thus required, in order to prevent or diminish the serious injury to streams which is at present taking place in certain districts.

* Excepting at week-ends, when the filters receive some fresh water, displacing some of the liquid held up.

SUGGESTED AMALGAMATION OF SOUTHPORT COMMITTEES.

At the Monthly Meeting of the Southport Town Council last Tuesday, Mr. T. Hampson (the Chairman of the Electricity Committee) said the following resolution had been carried at a meeting of his Committee: "Resolved, that this Committee protest against the action of the Gas Committee in incurring expenditure on the provision of an electrical generator, and thus interfering with the legitimate work of this Committee." He said he considered the action of the Gas Committee to be one of the most unbusinesslike proceedings that it was possible to imagine. They had already got a cable leading from the electricity works into the gas-works; and it was a cable suitable for conveying the current. But instead of allowing the Electricity Department to supply the current, they bought a gas-engine for generating electricity, at a cost of £90, and £9 for cable. The Gas Committee said they were making the current cheaper than the Electricity Committee would sell it to them. They might, but he doubted it. His experience was that it did not pay to manufacture one's own current. In this case, the electricity plant was running 20 out of the 24 hours without a day-load; and the Gas Committee could have helped to take the electricity when the load was small, and so saved the Corporation scores of pounds. He proceeded to refer to another resolution of his Committee, to the effect that gas and electrical meters should be read by one class of inspector. He said at the present time many consumers of electricity were also consumers of gas, and there was no reason why the two meters should not be read by one inspector.

The Chairman of the Gas Committee (Mr. Richardson) said that the Electricity Committee were asked to supply the current; but they would not let them have it at less than 1½d. per unit, whereas the Gas Committee found they could generate it at ½d. He would give another case. The Tramways Committee were now the Electricity Committee's largest customer; and they charged them 1½d. per unit, while they charged smaller customers less. They were taking £1000 from the Tramways Committee every year to bolster-up their own Committee. The Electricity Committee had refused to buy coke from the Gas Committee, though by so doing they would have saved a great amount of money in their coal bills. He thought the two Committees ought to be under one management, and worked for the benefit of the Corporation, and not run one against the other.

After some further discussion, the censuring resolution was, on the suggestion of Alderman Griffiths, withdrawn.

The employees of the Radcliffe and Pilkington Gas Company have been granted a war bonus. Every employee over 21 years of age will receive 2s. weekly, and those under that age 1s.

PRIMITIVA GAS COMPANY, LIMITED.

Conditions of Gas Trading in South America during the War.

The Annual General Meeting of the Company was held last Friday, at the River Plate House, E.C.—Mr. A. E. Bowen in the chair.

The Secretary (Mr. J. M. Macmorran) read the notice calling the meeting; and the Directors' report was taken as read.

Great Economy and Large Decrease of Consumption.

The Chairman, in moving the adoption of the report and accounts, said the shareholders met this year in abnormal times; and he regretted very much that he had not a better tale to tell them. He could assure them, however, that it was a pure case of misfortune. Nothing had been left undone either here or by the Local Committee and Manager in Buenos Ayres to effect the most stringent economies; and the greatest efforts had been made to improve the sales of gas. Last year when they met, he mentioned that the state of things then ruling in Argentina almost constituted a crisis; and these conditions became rapidly worse, resulting in such a crisis as had never before been experienced in the country. In Buenos Ayres at the end of 1913, there were no less than 25,000 dwelling-houses and offices vacant. Last year this number was raised to upwards of 40,000; so it would be readily understood what a serious effect the continued financial stringency had had on the Company's business. The decrease in the amount of gas sold for private lighting in 1914 was no less than 34 per cent., although they did not lose any business of importance to the Electric Lighting Companies. In the sales of gas for heating, power, and cooking, there was a small increase; but the total reduction in the amount of accounts rendered to customers was no less than 13 per cent. on the total volume of business of 1913, or £145,000. The principal factor affecting the sales, had been the complete stagnation in trade; and this and the want of money had compelled all classes to use great economy. Taking out the necessary data to find to what extent this had affected the Company, they learned that, on the 358,350 accounts issued for private lighting, there was an average decrease of $1·04 per account per month; and on the 386,008 accounts rendered for heating and power, the average decrease per account amounted to $0·82 per month. These two amounts alone had on the year's working affected them to the extent of £60,000, and also accounted for a decrease of 6 per cent. on the total gas sold. When war broke out, the bad state of affairs already existing was greatly accentuated. Money was almost unobtainable; and the Company suffered in common with all others trading in the Argentine Republic. During the year, they had lost 5958 consumers—principally owing to the non-payment of accounts; and he was sorry to say the amount that had to be written-off revenue for bad and doubtful debts had been double that of any previous year. They had to cut-off supplies from many houses and offices rather than run unnecessary risks of incurring bad debts. Their experience was that any account not collectable in two months was bad; so that they cut off the gas outside the house rather than run any further risk. In spite of this, however, the services were increased on balance by 3658, making a total of 203,755.

An Extended Business Foundation.

Referring to the report, it would be seen that the mains had been extended by 22 miles, to a total of 1128 miles. In addition, approximately 16 miles had been revised, repaired, and renewed. Considerable expense had had to be incurred in raising or lowering the mains at street crossings, by order of the Sanitary Works Department, to make way for new 36-inch water-pipes which had been laid right across the city. To-day the Company were lighting 17,206 public lamps, which was 779 more than last year; and they had still to fix, in accordance with the public lighting contract, 2704 lamps.

Bye-Products, Coal, and Heavy Freights.

The Directors had hoped that during the year a substantial profit would have been made out of the chemical plant; but the same adverse conditions which affected the gas sales were even more in evidence in reducing the sale of all the chemical products. Local sales of ammonia and sulphuric acid became impossible; and the high rates of freight ruling prevented the exportation of these products from Argentina. It was fortunate that the Directors had contracted carefully for coal supplies; otherwise they would have had a very much worse story to tell. He need not enlarge on the difficulties of keeping up the supplies of coal since the war broke out. Freights had risen enormously, and had been, and were, a source of anxiety to the Board. Under the terms of the concession, however, the Company were unable to raise the price of gas to the consumers to meet advances in coals and freights, which they had therefore to bear themselves.

Capital and Balance-Sheet Items.

Turning to the accounts, the net additions to capital for the year were £60,738. It would be understood that while the Board had rigidly abstained from any avoidable increase in capital expenditure, certain work, such as extensions of mains, must go on. The usual 10 per cent. had been written off office furniture, &c. The German Electricity Company had remitted from Buenos Ayres the purchase instalments due. They had again written-off out of revenue £35,000 for the Retiro amortization account, making a reduction of £175,000 in the last five years. In April, the Directors decided to offer the unissued balance of the ordinary shares to the shareholders. At the date of issue, the Company's prospects, to all appearances, were distinctly improving. They then had cable advice of the January and February profits; and they showed an improvement of £2400 over the corresponding period of 1913. The Board had not the slightest idea, nor could they foresee what a serious state of affairs for Argentina, and indeed for the whole world, would occur. They therefore thought that a fair price at which to offer the shares would be £6—that was, £1 premium. Out of the 40,000 shares offered, 30,089 were taken up; thus increasing the ordinary share capital by £150,445. He might say that his colleagues and himself took up considerably more than their proportion of the shares, at the issue price, after it was seen that the other shareholders did not want them. Out of the premium obtained, amounting (after deduction of expenses) to £29,460, the Directors had written-off the whole of the balance of the expenses of issue of the 4 per cent. debenture stock (1911)—viz., £24,249, which now disappeared from the balance-sheet, and the amount of £5211 had been added to the reserve fund, raising it to £95,211. The Board had amortized £7400 of the first debentures; thus reducing the amount to £484,200, as against £491,600. Further purchases on the sinking fund account had been made since Dec. 31. The River Plate and Buenos Ayres (New) debenture stocks were reduced by £7021 by the operation of the respective sinking funds.

The Profit and Loss Account.

With regard to profit and loss. The revenue was £255,809, as against £340,474—a decrease of £84,665. Debenture interest was almost the same as in the previous year—viz., £66,459, as against £66,950. Regarding income-tax, by which he meant income-tax remaining to be borne by the profits after taking credit for the sums deducted on payment of ordinary dividend and debenture interest, this amounted to £12,516, as against £6228 in 1913, or practically double. This left only £179,326 to carry to appropriation account, against £274,424 last year—a falling off of no less than £95,098. But the Directors had been able to provide for the dividends on the preference shares; and to transfer to the pensions fund £3000, and the usual £35,000 for the Retiro amortization account. He doubted whether the Board could have recommended any further dividend on the ordinary shares, even if they had not provided for the amortization, because, owing to the enormous advance in the cost of coal and freights, they required much more working capital to run the business—in fact, quite double what was necessary last year. Besides this, he was sorry to say that, although their relations with the Municipal Authorities were most cordial, they had not been able to pay the lighting accounts punctually, and to-day they were owing a very substantial sum. The Company would, of course, collect the money all right; but meantime it was a source of anxiety to the Directors, because it was impossible for them to raise any more capital, and it would be ruinous for both the Municipality and the Company if the Directors were obliged to curtail the supply of gas owing to want of money to pay for coals and freights. The Board were appealing to the authorities to help the Company by allowing them to charge meter-rent. If they succeeded in obtaining this concession, he should not feel nearly as anxious and worried as he did now.

The Outlook.

As to the future, it was quite impossible for him or anybody else to say anything definite about the prospects. He could only tell the shareholders that the Directors were experiencing the very greatest difficulty in obtaining supplies of coal, even from their contractors. Yorkshire gas coals, which were quoted about 12s. to 14s. per ton before the war broke out, were unobtainable in any quantity to-day, and the small lots which could be picked up were worth about 25s. per ton. At this time last year, they were paying 14s. freight to Buenos Ayres; now they had to pay 32s. 6d. (though there had been a slight drop from this), owing to the difficulty of stemming steamers. Then they had to pay war risk insurance and many other abnormally heavy charges. All the materials used in the business were costing very much more than before the war—in some cases double. Fortunately, they had a good stock of gas oil, bought at reasonable prices; and considerable quantities of water gas were being made. The foregoing were bad points; they could hardly be worse. *Per contra*, things in the Argentine Republic were on the mend; and he was pretty certain that the worst of the crisis had been seen there, and that conditions would improve from now onwards. Enormous prices were being obtained for everything the country could produce; and there were eager buyers for the whole of the crops. In these circumstances, he thought they might fairly hope for an improvement in the business, though he must tell the shareholders that a cable just received from the General Manager informed the Board that the profits for the first quarter of this year were £3000 less than in the corresponding quarter of 1914, caused principally by the high cost of coals and freights. But he had been connected with the Buenos Ayres gas industry for 35 years; and this was the first serious set-back he had ever witnessed in that period. Times were quite abnormal; and he was, therefore, hopeful that they were only suffering from these peculiar circumstances, and that everything would come right in time. He hoped and thought it would not take long.

The Terms of the Concession.

He should just like to say a few words about the terms of the Company's concession, because he had had two letters about it from shareholders who seemed to think that, at the end of twenty years—say, in 1929—the works and properties of the Company had to be handed over to the Municipality. Nothing of the kind. The works and properties belonged to the Company in perpetuity; and at the end of the twenty years, they simply had to again arrange selling prices. He hoped sincerely, when that time came, they would be able to secure a sliding-scale basis on something like the same lines as the London Gas Companies worked on.

The Work in Buenos Ayres.

He wished also to allude to the anxious work of the Local Committee and General Manager in Buenos Ayres. It was in critical times that the business requires more and more attention; and every item of expenditure had to be carefully watched. The instructions of the Board to keep down expenditure in every way consistent with true economy, had been followed to the very letter.

Mr. H. E. Jones, in seconding the motion, said the prospect was that the difficulty was only temporary, and things would pass over like the fearful war which was making things so terribly hard for all English gas companies, as well as for those in the Argentina.

Mr. W. H. Skeel remarked that those interested in shipping knew what a heavy price was being paid for coal. In the past year it was easier to lose money than to make it in Argentina; and these two things went a long way to explain the present circumstances. This was the only time the Board had given them a weak report. With regard to the reserves, he hoped, when the question of an interim

dividend came before the Board, they would remember that the shareholders were something like the Company—they had to carry-on with extra taxation, and were probably asked to subscribe to various funds. Reserve funds were made to be used in abnormal times. The shareholders had ample confidence in the Directors.

Mr. E. C. HUMPHREYS remarked that he understood the Chairman to say that they were now charging the maximum price for gas permitted under the concession. Had the Board at any time been able to reduce the price below the maximum? It was quite evident the concession did not in the maximum price allow for contingencies. He hoped the Board would be able to prevail upon the Municipality to allow meter-rents, though he had his doubts on the point.

The CHAIRMAN, in reply, said the reserve funds accumulated by the old Companies were given to the shareholders in the shape of bonus shares when the amalgamation took place. He had wished thousands of times since that the shareholders had not had these shares. The Board were now engaged in building-up another good reserve fund. But they had had one crisis after another with which to contend; and things had been against them. In the concession the price of gas was fixed, until a certain quantity of gas was sold; then they had to reduce it, or rather it would be reduced automatically. Discounts were made to large consumers in the past; but the Company could not afford to allow them just now.

The motion was unanimously carried.

Moved by the CHAIRMAN, and seconded by Mr. C. J. HEGAN, it was resolved that the balance of profit and loss account—viz., £61,970—be divided as follows: To the pension fund, £3000; to Retiro works amortization account, £35,000; and to be carried forward to new account, £23,970.

The three retiring Directors—Messrs. H. E. Jones, J. C. im Thurn, and C. J. Hegan—were re-elected, as were also the Auditors.

The CHAIRMAN next proposed a vote of thanks to the staffs in Buenos Ayres and London. He said that during the year they had had the pleasure of a visit from the Chairman of the Local Committee (Mr. S. Hale Pearson); and the Directors took the opportunity of talking over all pending matters with him. His advice was most useful to them. He and his colleagues on the Local Board had had as anxious a year as the Board had had. He was sure they could not be too grateful to them and to their General Manager (Mr. Angus) for the care and attention they had given to the Company's affairs. He was afraid Mr. Angus in particular had been overworked; but fortunately he was a strong man in every sense of the word.

Mr. H. E. JONES, in seconding, said that, in his experience of 45 years, it was a rare thing for a gas company to pass the dividend. Anything that he and his colleagues could do would be done to restore the dividend to its original amount.

Hearty thanks were also voted to the Chairman and the Board.

BURTON MUNICIPAL FINANCES.

The price of gas within and outside the borough of Burton-on-Trent, for motive power and other manufacturing purposes, is to be increased 4d. per 1000 cubic feet, and for all other purposes (including supplies through prepayment meters) 6d. per 1000 feet. In all cases the advance commences after the reading of the meters at June 30.

Alderman LOWE, in moving the adoption by the Town Council of the report dealing with these increases, expressed the hope that the rise in price will be only temporary, and pointed out that the dominating factor which had influenced the Committee was the increased cost of production. Coal had gone up about 5s. per ton; but fortunately they overbought at last year's price, and had contracts for a sufficient amount of coal at the old rate to take them through at least a third of the year. Taking all the additional items into account, however, they must make provision for an extra £8000 for cost of manufacture; and the Committee's recommendation, it was estimated, would bring in about this sum. Some members might take exception to their differentiating between the price of gas for manufacturing and power and for other purposes. The increase of 6d. per 1000 cubic feet on the charge of 2s. for lighting was equal to 25 per cent. advance; but if they were to add 6d. to the price for power, it would be equal to an advance of 40 per cent., which they felt would be a very heavy demand on the manufacturers. It was therefore proposed to make the increase for manufacturing purposes 4d., which was similar to that on lighting—viz., 25 per cent. There was another reason which appealed to him with far greater force. Many firms, who were at present paying hundreds a year for their gas, had gas-producers a few years ago. The Corporation induced them to give these up owing to the low price at which they were able to sell them gas; and they felt that it was only equitable that in making the advance this fact should be borne in mind. The rise was a large one; but he asked the Council to remember it was attributable to the war. Concessions which the users of gas and the men at the gas-works had received, as compared with the time when he first became Chairman of the Committee, amounted to an annual sum of £21,500; and during the last fifteen years the rates had benefited to the extent of over £101,000, equal to the whole of the amount to be provided for in the rates this year.

The contribution from the Gas and Electricity Departments for the year ended March 31, 1915, for the relief of rates, was £7000; and for the year ending March, 1916, it is to be £5000. The allocation between the two departments has not yet been decided upon. The rates are being advanced from 7s. 10d. in the pound last year to 8s. 6d. this year. It is pointed out that the granting of half-pay to all Corporation employees promised at the beginning of the year to men who have enlisted is now costing the Corporation £3200 a year. In the Gas Department, 33 employees, representing over 20 per cent. of the average number engaged, are now on military service; and half-pay to these men alone comes to over £1100 per annum. The Corporation are also granting a special war bonus to all male employees earning up to 40s. per week, which is estimated to cost £2300 per annum for the whole of the town, and over £500 in the case of the gas-works.

OLDHAM LIGHTING RESTRICTIONS REMOVED.

At the last meeting of the Oldham Lighting Committee, Mr. Hardman (having previously raised the question at a meeting of the Gas Committee) passed severe strictures upon the restricted lighting in the town, and asked the Town Clerk point-blank whether they were compelled to obey the Military Authorities. The Town Clerk said he had not studied the order particularly; but, speaking off-hand, he should say they were. Mr. Hardman then stated that he thought it was most unnecessary and unwise to put the town in darkness to the extent it was now. Leeds, Bradford, and Sheffield were nearer the coast, but were not so severely restricted in regard to lighting.

On Tuesday, however, the town suddenly returned to its normal state of lighting; the order for restrictions having been cancelled by the Military Authorities. The change has been welcomed in the town, particularly by the cotton operatives. It was well known that certain of the streets were dark and dangerous even in normal times; but with restricted lighting the whole town was dangerous.

The neighbouring towns of Ashton-under-Lyne and Bury have also had their restrictions on lighting withdrawn. The military regulations regarding lighting have also been cancelled at Heywood and Wigan.

A PROTEST AT SHEFFIELD.

Reduced Lighting and More Accidents.

The interpretation of the Home Office Lighting Order was discussed at last week's meeting of the Sheffield City Council.

Sir WILLIAM CLEGG, in introducing the subject, said he was quite sure all of them would accept without demur any inconvenience which was absolutely necessary to meet the needs of the situation. They realized, of course, that at present Sheffield was one of the most important cities in the country for manufacturing steel and the munitions of war. In reading the Order, it appeared to him that it was both inconsistent and illogical. It was a positive danger to the citizens, to drivers, and pedestrians of all kinds, as it was administered at the present time. During the time the Order had been in operation there had been four fatal tramway accidents - a percentage utterly out of all proportion to the normal condition of things. He had the authority of the General Manager to say that one fatal accident was brought about by the darkness of the spot where it occurred. He asked the Watch Committee to carry out the Order in a more reasonable manner. While lights were necessarily allowed in the large armament works for their own purposes, why need there be any restriction in other parts of the city? Why should most of the city be put in darkness and subjected to annoyance and danger, when anyone on an eminence could see a blaze of light from the works? He was not blaming the Watch Committee; but he did ask them to exercise more care.

Alderman CATTELL pointed out that the Watch Committee had a most difficult duty to carry out. If the inhabitants of the city only realized that the Order was absolutely essential, he was sure they would bear their burden with the greatest cheerfulness. The Council might rest assured that what had been done had not been done without good cause.

Mr. BENSON remarked that of the two military experts who had been called in, one was from London and the other from Doncaster. Their views were entirely different.

Mr. WALKER said the Lighting Sub-Committee had increased the lighting at dangerous spots, and he would ask the Committee to go into the matter once more.

Mr. ANGELL informed the Council that the Order was enforced after consultation with the Admiralty and the War Office. Supposing the Watch Committee had not carried out the instructions and something happened resulting in loss of life, on whom would the responsibility rest? A great deal of the glare from the works had been relieved by the manufacturers.

BRADFORD LIGHTING ARRANGEMENTS.

The Restrictions Criticized.

A question as to who had authorized the curtailment of the lighting in the city streets led to a long discussion when the minutes of the Gas Committee were before the Bradford City Council at their meeting on Tuesday last.

Mr. J. H. BARRACLOUGH (the Chairman of the Committee), replying to the question, said it was decided at a meeting of the Committee on March 26 to reduce the lighting by one-half; and the next morning a Government order came along, in consequence of which the lighting was brought down to the present conditions.

Alderman PICKLES said he understood the carrying out of the military order meant that notice had been given to over a hundred lamplighters. He thought that these men should not be thrown on to the industrial scrap heap. The Government, who had come to the rescue of railway shareholders and other members of the community, ought also to help these lamplighters. The curtailment of lighting made the city dangerous. Several cases had been brought to his notice of people being stopped in dark corners. There were narrow lanes and passages in the city where the lights were turned out. In the interests of decency, and for the protection of the lives and limbs of the citizens, there should be more light in such places. He hoped the Gas Committee would insist upon their right to do their duty to the citizens. The average military officer who interfered in civil affairs showed a lamentable lack of business capacity. The order had been sent to a number of towns in the district, and it was variously interpreted. Leeds, for instance, got a fair amount of light. In his opinion, irrespective of who was responsible for the stringent interpretation of the rules and regulations, the Council should give an instruction that some relaxation should take place.

Mr. GLYDE suggested that some arrangement might be come to

between the Gas and Watch Committees, whereby the whole of the lamplighters affected by the lighting regulations should be appointed special constables, to patrol the out-districts of the city.

Alderman CONWAY remarked that the Chief Constable and the Watch Committee said there were no more cases of crime against the person since the restrictions came in than there were before; but he had come across cases of molestation that were not reported to the police. If the city had a police force three times its present size, the constables would be helpless because of the darkness. There were general complaints, too, among retail traders that the reduction of lighting in their windows meant diminution of profit. With regard to evening schools, the order had gone forth that ordinary classes must be shut-down. The young people would not attend. No doubt the authorities of the Military Command were actuated by the best intentions; but representations should be made as to the great inconvenience caused. The necessities of the case had been exceeded.

Mr. BARRACLOUGH, replying on the debate, agreed that the order had been carried too far. His Committee would, he said, be only too glad to improve the lighting. It was true that the lamplighters had been given notice to leave; but he could assure the Council that every one of them would be found suitable employment.

The minutes were adopted.

ELECTRICITY CHARGES AND THE WAR.

The question of the St. Marylebone Borough Council increasing their charges for the supply of electricity [which was recently discussed, as reported in the "JOURNAL" for the 23rd ult., p. 760] was again before the Council last Thursday, on a report by the Electric Supply Committee. A considerable reduction in the consumption of electricity for private lighting was, the Committee reported, anticipated; and it was assumed that the restrictions in connection with outside lighting would remain in force for some period. At the same time, their expenditure was increasing. The Committee proposed an advance of 10 per cent. on the accounts of consumers, to take effect from the beginning of the June quarter. When the estimates of the Committee were presented to the Council, Mr. D. M. Isaacs suggested that even more than the 10 per cent. increase should be imposed on the electricity consumers who were obtaining their supplies at ½d. per unit—a price very much below the cost of production, exclusive of establishment charges. Mr. Duncan Watson (the Chairman of the Committee) explained that the decrease in the sales was partly due to the provision which was being made for their employees on active service, involving an entirely unproductive annual expenditure of £2000. Notwithstanding the 10 per cent. increase, the estimated average price of electricity during the ensuing year worked out at 2·81d. per unit, representing about 30 per cent. less than the price for the current year.

CENTENARY OF GAS LIGHTING.

Introduction of Gas into Devonshire.

Gas lighting was no longer a novelty to the inhabitants of London in the spring of 1815; but it had then still to make its way in the Provinces. One of the earliest notices of it in the South West of England appeared in the "Western Luminary," published at Exeter, on April 10, 1815, and was in these terms:

> "Mr. Alderman Phillips's shop in the Fore Street, Exeter, has for some weeks past been lighted with gas, by the skill and science of Mr. Reuben Phillips (the Alderman's eldest son), whose first course of philosophical lectures and experiments, delivered last winter to select companies of friends, was so much admired. The gas-lights are of extraordinary beauty and brilliancy, and would, in a few years, produce a great saving, if generally adopted throughout the city."

In common with other cities and towns, Exeter was very indifferently lighted at that time. A few oil-lamps here and there made a pretence of lighting the streets—it cannot be described as anything else—while houses and shops depended, in the main, upon candles, which were sparingly used unless some special occasion called for a lavish display and an illumination. An advertisement published in the "Exeter Flying Post," in the year 1793, shows what were the ideas of the city rulers of the period upon the matter of street lighting. It invited tenders "for lighting, snuffing, maintaining, and repairing 131 street-lamps in the streets and suburbs of Exeter. Each lamp to contain two spouts; sixteen strands to each spout; the wick to be of cotton yarn; and the oil to be the best lamp-oil." What result was obtained from this method of illumination the same newspaper was at some pains to tell us. In an article which appeared in the issue of March 8, 1804, the Editor describes at length the improvements which were needed in the government of the city, and in reference to the lighting of the streets remarks:

> "It may be said we have lamps, but to what purpose cannot well be discovered. They are so few, placed at such a remote distance from each other, and above all affording their most execrable glimmer not two hours after they have been lit, that they scarcely make darkness visible, much less assist the benighted passenger on his way. It is, indeed, a libel on a lamp to honour a piece of twisted yarn, dipped in the coarsest oil, and which will scarcely retain its flame while the lighter descends from the ladder—I repeat, it is a libel on a *proper* lamp to honour such a glass case with a similar name."

Exeter, however, had to make the best of this "execrable glimmer," until Mr. Reuben Phillips's experimental lighting of his father's shop, more than a decade later, demonstrated to the admiring citizens that there was something far better to be obtained in the way of illumination. His enterprise quickly bore fruit. In May, 1815, a meeting was

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called to consider a proposal for adopting gas lighting. A Committee had been got together, and on its initiative Mr. Phillips, sen., and two other persons with mechanical knowledge, had been sent to London to obtain information as to the new method of lighting and the success which was reported to be attending it. The results of their investigation were communicated to the meeting, and were considered so satisfactory that it was forthwith resolved to form a company to supply gas in Exeter. The Exeter Gas Company, which thus had its birth, was constituted with a capital of £12,000 in £50 shares. One laudable idea with which the promoters set out was to distribute the advantages which they expected to derive from the new undertaking over as wide an area as possible, and at the same time to secure a large number of consumers by making many people interested in its prosperity as shareholders. It was therefore decided that the holding of any one person should be limited to five shares. Whether the applications for shares were sufficiently numerous to justify this strict limitation, is not clear. Possibly they were not; for after an interval of a few months, the individual holdings were extended to ten shares.

As was natural, the "Flying Post," which had been so critical of the older illumination, gave the new enterprise its blessing. It pointed to the success of gas-lights in many streets of the Metropolis, and added: "The brilliancy of the gas-light is so superior to that of oil or tallow as to bear no comparison with it, while the saving in point of expense is so considerable that we make no doubt the plan will be eagerly encouraged by the inhabitants of this city, and that it will be speedily adopted in every considerable town throughout the kingdom." The rival organ—the "Western Luminary"—was not less enthusiastic. It devoted an article to describing how "the gas is obtained from its being exposed to a red heat in closed vessels of cast iron, having a communication by a pipe with an apparatus in which are received all the considerable products, chiefly tar." The readers were assured that "for brilliancy, safety, and freedom from smell, the gas lights exceed any kind of artificial light hitherto discovered." With regard to the question of safety, it is interesting to notice that there was no reason to apprehend danger from the bursting through internal pressure of the underground pipes by which the gas was to be distributed. As a preliminary to more serious operations, the Company fitted up a temporary "laboratory" at Mr. Reuben Phillips's house, and during November, 1815, laid a pipe in Fore Street from which a few of the shops in that business thoroughfare were being supplied with gas. These places, "lighted" as the local chronicler of the time says, "by the twin sisters Science and Taste," were the objects of nightly admiration. By April, 1816, the Exeter Gas Company had obtained their Act of Parliament. A site for the works had already been secured, pipes were laid in Fore Street, and, though the progress was not exceptionally rapid, July, 1817, found the whole of the street lighted with gas—exhibiting, in the words of the "Flying Post," "a most brilliant appearance, and forming a striking contrast to the poor glimmering lights which have hitherto disgraced our streets." Naturally, the principal tradesmen were quick to adopt the new method of lighting, the advantages of which had been demonstrated by its experimental use by a few of their number; and the new Company was able to look forward with confidence to the time when the use of gas would become general in the city.

So interesting and novel a departure from the custom of centuries in the matter of lighting invested Exeter with a peculiar interest in the West of England. People from the surrounding towns and villages flocked into the city to see the new lighting and speculate on how it was done without any of the customary aids of wick and oil or tallow. But though curiosity was excited, there seems to have been little desire to emulate the example which the county town had set. Seven years elapsed before Plymouth, even then a larger town than Exeter, had a supply of gas. In 1823, a Company was formed for supplying Plymouth with gas manufactured from oil. The scheme had been under consideration ever since 1817; but though so long on the way, the Company did not in the end secure a monopoly, and two years after they began operations, the United General Gas Company was in the field with a project for supplying coal gas in Plymouth, Stonehouse, and Devonport. The oil-gas enterprise does not appear to have been very successful; and in 1832 it became merged in the United General Gas Company, which, in its turn, gave way in 1845 to the Plymouth and Stonehouse Gas Company. Devonport, which had received its first supply of gas from the United Company, afterwards shook off its connection with Plymouth; and in 1845 the Devonport Gas Company was formed for the supply of gas in the borough. This Company continued to exist until Jan. 1, 1902, when the undertaking was acquired by the Devonport Corporation. Now that the three towns are amalgamated, the Devonport works are under the control of the Plymouth Corporation; but the Plymouth and Stonehouse Gas Company remain in possession of their old area, and are gradually feeling their way into suburbs beyond the municipal boundary.

Of the other Devonshire towns, Tavistock was the next to light its streets with gas; the Gas Company there having been formed in 1830. In the following year, the Tiverton Gas Company was formed, with a capital of £1100 in shares of £10 each; and in March, 1832, the streets of the town were lighted with gas. The new method of illumination must, however, have been considered as somewhat of a luxury; for the original cost was 15s. per 1000 cubic feet, and in 1843 it was still as high as 10s. Nevertheless, the undertaking prospered in a modest way, and in later years, under the Corporation, has made marked progress. In Barnstaple, gas seems to have been first used in the year 1833; but it was four years later before it appears to have been employed for street lighting, and in 1839 there were only 65 public gas-lamps in the town. Oil-lamps, in fact, continued to be used in the suburbs until as late as 1855. The local historian notes that, when gas was originally used, a charge of 7s. 6d. per burner per night was made for it in the market. It says a great deal for the popularity of the new method of lighting that it was able to make any headway at all in face of such a charge. When the gas was sold by meter, the cost was 10s. per 1000 cubic feet; but this was not a remunerative

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price, and the charge was shortly raised to 12s. Up to 1868, the gas-works were in private ownership, and were carried on by lessees. A new Company was then formed. In 1869, an Act of Parliament was obtained; and the undertaking made a new start on a career which has since been prosperous and progressive.

In Bideford, Kingsbridge, and Torquay the introduction of gas dates from 1834, in Honiton and Totnes from 1835, and in South Molton and Torrington from 1836. Some year or two after the Torquay Gas Company came into existence, there was much talk of opposition undertakings; and two were projected—one to be called the Torquay Gas Consumers' Company, and the other the St. Mary Church Gas Company. Neither of these schemes came to maturity; and the original Company remained in possession of the field. The site of the first works proved unsuitable; and in 1859 the foundation stone was laid of the present works. Though well adapted for the purpose in most respects, the new works appear to have been at some disadvantage in being situated at one extremity of a district straggling over hills and dales; and after a time the Company sold their interest in the supply of gas to the St. Mary Church district to the Local Board of Health then governing this area. When St. Mary Church became part of the Borough of Torquay, the St. Mary Church works passed into the possession of the Corporation, and are now maintained as a separate undertaking.

Newton Abbot, a near neighbour of Torquay, began to enjoy the advantages of gas lighting about the same period; the Newton Abbot and Newton Bushell Gas and Coke Company (now the Newton Gas Light and Coke Company) having been formed in 1835, and the supply of gas commenced in 1837. Many other towns followed more or less leisurely. Sidmouth and Axminster were first lighted with gas in 1838, Teignmouth in 1839, Ashburton in 1840, and Exmouth in 1843. Crediton, though only six miles from Exeter, did not follow the example of the city until 1848. Then came Dawlish, in 1846, and at a long interval Okehampton, whose streets were not lighted with gas until 1859—more than forty years after the first appearance of gas in Devon. In a few of the smaller towns, gas was introduced at a later period. In Modbury it first appeared in 1864, in Cullompton in 1865, in Budleigh Salterton in 1867, and in Colyton in 1871.

Some of the smaller towns of the West have not made much progress industrially or in population during the past fifty or a hundred years; and in these the gas undertakings continue on a modest scale. Others have been transformed into thriving health and holiday resorts; and there the gas companies have shared in the advancing prosperity, and become flourishing and steadily developing institutions. Most of them have in recent years had to encounter keen opposition from the electric light. A few have passed from the control of the original companies to that of the local authorities. But whether big or little, whether owned by companies or by the municipalities, the gas undertakings of Devon have proved successful from the commercial standpoint, and have contributed to the comfort and well-being of the communities which they serve.

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

The announcement made in Dundee, that selections are to be made from the workmen employed by local authorities for employment in factories producing munitions of war, has not caused any surprise among the heads of departments of the Corporation. Early in the month the Town Clerk received a communication from the Board of Trade Labour Exchange dealing with the organization of labour, and stating (*inter alia*) that it was hoped local authorities would give every facility to skilled employees desirous of working in factories producing munitions of war which were vital to the nation's interests. This document has been circulated among the various departments. No intimation, however, has yet been received of a proposed levy of skilled workmen. In the course of an interview with a representative of the "Dundee Advertiser," the Gas Engineer and Manager (Mr. Alexander Yuill) said his department had sent about 100 men to the Colours. Asked as to the probable effect if a further drain were made in the shape of a Government levy, Mr. Yuill said: "My position is like this: If the Government require more men—and I have no doubt they do—it is our duty as a local authority to give them all the facilities we can. The Government recognize that the supply of gas must be maintained; but most local authorities have large numbers of men who are not engaged in the actual manufacture and distribution of gas. In our case, we have a great many gas-fitters employed in the fixing of cooking-stoves, fires, &c. But these things are of secondary importance when you consider the present position of matters; and we would give all the assistance we possibly could to the Government in releasing these men for service. It must be clearly understood, however, that if we give these men to the Government we shall not have the same facilities at our command for attending to the needs of our consumers; but that is a secondary consideration. The Government have no desire to take away men actually engaged in the manufacture of gas. In fact, they passed an order some time ago to the effect that no employee of the gas-works was to enlist unless with the sanction of the manager."

The subject of the reduced lighting of Glasgow streets was brought forward at the meeting of the Town Council on Thursday. Replying to a question, Mr. Bruce Murray said the public lighting had been reduced by about 40 per cent. so far as gas was concerned, but there had been no change in the case of electric light. The reduction was carried out as far as possible on a uniform scale in all districts, except one or two special places where reduced lighting was not deemed advisable. The saving was at first estimated at £300 per week; but it became less as the length of darkness decreased with the advancing season. It might be estimated at £2000 till the end of the financial year in May. No complaints had been received from the police of additional crime due to the reduced lighting.

On Wednesday morning the labourers employed in the Corporation

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FUMES from Cooker Hot-plate Burners usually escape into the Room. In small dwellings this is disagreeable, and repels otherwise likely consumers.

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Gas-Works at Wishaw struck work. On the previous Monday evening they had a letter before the Town Council complaining of unfair treatment in this respect—that, having some time ago applied for and been granted an increase of 2s. per week, which put them on a level with other burgh employees, this sum had been deducted from the 3s. war bonus now being paid by the Council. The Convener of the Gas Committee explained that it was owing to the increased cost of living that the labourers at the gas-works had been given an increase of 2s.; and when a few weeks later the Town Council resolved to pay a war bonus, this increase was considered as part of it. The men at present were being paid 27s. weekly. The Council remitted the matter to the Finance Committee, with an instruction that if any further increase were granted it should be retrospective. On the following day this decision was communicated in writing to the men. On Wednesday morning, however, the Manager (Mr. P. B. Watson) was met with a demand that the increase should be given in this week's pay. The assurance that their application was under consideration did not satisfy the men, and they left the premises. Several other labourers also stopped work.

At the meeting of the Perth Town Council on Monday, an extension of the Almondbank scheme of gas supply to Pitcairnfield was sanctioned. The Engineer's estimate of the cost was £300; and no additional expense will be incurred at the works.

As the result of the proceedings at the meeting of the Arbroath Town Council last Monday, an experiment is to be undertaken to show the merits of gas as compared with electricity for public lighting. The Lighting Committee recently resolved to ask the Gas Committee to state at what figure they could supply gas lighting if necessary, and, if thought advisable, to take the place of the present electric lighting of the streets. At the meeting of the Council on Monday, it was intimated by the Lighting Committee that the Gas Manager (Mr. A. C. Young) had reported on the subject, and had recommended a system of either low or high pressure lamps. The Committee had resolved to arrange for the erection of the two lighting systems in the High Street, and to judge the effect. Mr. Mackenzie moved the disapproval of the Committee's minute, first on the ground that the change from electricity to gas in the High Street would be a retrograde step, and next because the Committee had not placed before the Council any statement as to the cost of one system as compared with the other. Dean of Guild Beck seconded the motion. Mr. Stewart submitted that, as it seemed to be a struggle between electric light and gas, they should have an exhibition of the electric light on the same night as the gas systems were to be shown. On a division, the Committee's minute was adopted by 12 votes to 5. The same question subsequently arose out of a minute of the Gas Committee authorizing the Gas Manager to purchase and fit up the standards, lamps, and fittings required. Mr. Mackenzie again moved the disapproval of the minute. The town, he said, was at present under military law as regarded lighting, and he held that the present was not a time for satisfactorily testing the different lighting systems. The illumination might cause a glare which might be seen as far away as the Bell Rock, and the military authorities might object. Mr. Chapel, the Convener of the Lighting Committee, said they had already received the sanction of the military authorities to carry out the experiment. The minute was adopted by 12 votes to 5.

Prior to the ordinary meeting of the Alloa Town Council on Monday, the councillors met as a Gas and Electricity Committee, with Mr. Pearson, the Convener, in the chair. It was decided to recommend to the Council that the charge for gas to all classes of consumers should be increased by 6d. per 1000 cubic feet, owing to the rise in the cost of coal; the change to take effect as from the current survey of meters, and to continue for six months, when the question of readjustment will be considered and a report and recommendation made to the Council. Subsequently, Mr. Pearson stated to the Council that the Committee, in making up their estimate for the coming year, had found that the increase in the price of coal would necessitate a considerable increase in the price of gas to all classes of consumers. The expenditure during the current year for coal used in the works was £9458, and for next year the amount would be £15,587, which meant an advance of almost 10d. per 1000 cubic feet. The whole situation had been fully deliberated upon by the Committee, and it had been considered that the difference could be met by the department by the imposition of 6d. per 1000 cubic feet on the present rates charged to all classes of consumers. He moved that the increase recommended should be adopted; and the motion was unanimously agreed to.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *April* 19.

In the London tar market there is a distinctly improved feeling with regard to pitch. It is realized that the worst has passed, and that a gradual increase in price may be looked for if makers act with care in selling. The period of maximum production is over, and it will cause little inconvenience to hold the stocks in hand for better prices. Considerable quantities of pitch appear to be still required for shipment this season, while the local trade is good. Makers quote 27s. 6d. per ton net. Naphthalene and solvent naphtha remain in large demand. Creosote is firm at 4⅛d. net in bulk at makers' works. Sixties crude carbolic acid is worth about 3s. 8d. net, casks free.

As the best of the shipping season for sulphate of ammonia is just over, the value of this article is naturally a shade easier. Still there is little for sale for early delivery, and makers quote £13 10s. per ton filled into buyers' bags at producers' works for 25 per cent. quality.

Tar Products in the Provinces.

April 19.

The markets for tar products have remained fairly steady throughout the past week. There has been a slight improvement in pitch, there

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having been large inquiries from France. Benzol remains steady, and there is a fair amount of inquiry. Solvent and heavy naphthas are very firm, and distillers are all behind with their deliveries. There is no alteration in the price of crude carbolic. Creosote is quiet, and there are fair quantities of this article offering.

The average values of gas-works products during the past week were: Gas-works coal tar, 21s. 6d. to 25s. 6d. Pitch, East Coast, 21s. to 22s.; Norfolk, Suffolk, and Humber ports, 18s. to 19s. per ton; West Coast, 19s. to 20s. Manchester; 20s. to 20s. 6d. Liverpool; 23s. to 24s. Clyde. Benzol, 90 per cent., naked, North, 10½d. to 11d.; 50-90 per cent., naked, North, 1s. 3d. to 1s. 4d. Toluol, naked, North, 2s. 2d. to 2s. 4d. Crude naphtha, in bulk, North, 5⅛d. to 5⅜d. Solvent naphtha, naked, North, 1s. 5d. to 1s. 6d. Heavy naphtha, naked, North, 11d. to 1s. Creosote, in bulk, North, 3d. to 3⅛d. Heavy oils, in bulk, 3⅞d. to 4d. Carbolic acid, casks included, 60 per cent., East and West Coasts, 3s. 4d. to 3s. 5d. Naphthalene, £8 to £16; salts, 75s. to 80s., bags included. Anthracene, "A" quality, 2d. per unit; "B" quality nominally ¾d.

Sulphate of Ammonia in the Provinces.

LIVERPOOL, *April* 17.

Throughout the week there has continued to be little animation in the market for this article, and prices have tended slightly in the favour of buyers. The congestion on the railways and at the ports has not improved, and has stood in the way of the export trade, while the demand for home consumption has only been on a small scale. The quotations now are £13 6s. 3d. per ton f.o.b. Hull, £13 7s. 6d. per ton f.o.b. Liverpool, and £13 15s. per ton f.o.b. Leith. There has been more inquiry in the forward position, and several producers report that within the last day or two they have realized £13 5s. per ton f.o.b. good port for July-December delivery, in equal monthly quantities.

Nitrate of Soda.

The tone of this market has been strong, and spot prices are now 12s. 4½d. per cwt. for ordinary quality, and 12s. 7½d. for refined.

Sulphate of Ammonia.

From another source it is reported that this market has been very quiet throughout the past week, and prices have receded somewhat. Outside London, makes are quoted at £12 12s. 6d. to £12 15s.; Hull, £13 5s. to £13 6s. 3d.; Liverpool, £13 7s. 6d. to £13 10s.; Leith, £13 12s. 6d.; Middlesbrough, £13 10s.

Price of Gas Advanced at Heywood.—At a special meeting of the Gas Committee of the Heywood Corporation last week it was decided to increase the price of gas for all purposes by 3d. per 1000 cubic feet. The 2d. per 1000 cubic feet discount hitherto allowed for prepayment meters is to be discontinued.

COAL TRADE REPORT.

Northern Coal Trade.

There is continued activity in the northern coal trade, and shipments are fair. Those coastwise are full; but exports are much below the normal proportion. In the steam coal trade, the inquiry is strong, and should improve as the spring opens-out closed navigations. Best Northumbrian steams are steady at 30s. per ton f.o.b.; and for second-class steams, the price is about 27s. 6d. per ton. Steam smalls are rather scarce, are steadily held, and are quoted at 14s. 6d. to 16s. per ton f.o.b., according to the quality. This relatively high price for small coals is one of the features of the northern coal trade that are noticeable at present. In the gas coal trade, the demand is good, and the inquiry for the London district is said to be rather pressing. Best Durham gas coals are steady at 25s. per ton f.o.b.; second-class gas coals are 23s. 6d. per ton; and "Wear Specials" are firm at 25s. to 25s. 6d. per ton f.o.b. Very little gas coal appears to be free for shipment for the rest of the month, as the contracts are taking up so much of the output. Another factor is that the demand for Durham coals for local consumption is very full at present, and that at very good prices; so that there is an effect both on the gas coal available and on the prices asked for any quantities specially needed. Little is doing at present in contracting for gas coal, and the freight for its carriage seems higher just now. The coke market is very firm, with fuller exports. Gas coke is selling well, with prices occasionally higher, and varying from 16s. 6d. per ton f.o.b. upwards.

Watch Committee and a Gas Director.—A proposition in the Oswestry Town Council that Councillor Poole should be elected to fill a vacancy on the Watch Committee was opposed, on the ground that he was a Gas Company Director. Alderman Smith remarked that it had been a point with them that no director of a gas or electric light company should be on the Watch Committee, "as it was felt that the interests of the town would suffer." Accordingly, the Council elected another member to the vacancy.

Leeds War Bonus.—The General Purposes Committee of the Leeds City Council have decided, on account of the increased cost of living, to give employees receiving £2 a week or less a war bonus on the following scale: In the case of those earning under £1 per week, a bonus of 1s. per week; between 20s. and 30s., 2s.; between £1 10s. and £2, 1s. These payments are to continue in operation for six months, when the position will be reviewed. The bonus is to be granted equally to officials, members of the clerical staffs, and workmen. It was stated that under these concessions 396 men receiving less than £1 per week, 3087 in receipt of between £1 and £1 10s. per week, and 1641 who are in receipt of £1 10s. to £2, will benefit. The advances represent an increase per annum in the wages bill of the Corporation of about £21,300, equivalent to a rate of 2½d. in the pound.

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Great Grimsby Share Issue.—The recently advertised issue by tender of 1000 shares of £10 each in the Great Grimsby Gas Company has resulted in 820 shares being applied for, at an average price of £16 18s. 6d. The minimum price fixed was £16 16s. per share.

Nelson Corporation Gas-Workers' Wages.—An application has been received by the Nelson Corporation for an advance in wages for every employee, of 4s. per week. Though the increased price of food caused by the war is stated to be the reason for the application, a permanent increase is asked for, and not a war bonus. The matter has been referred to a Sub-Committee.

Birmingham Minimum Wage Increased.—A proposition brought forward by the General Purposes Committee has been agreed to by the Birmingham City Council, the effect of which is that the minimum wage will be increased by certain specified amounts. The principal point is that the minimum of 26s. per week paid to all able-bodied male employees not under 21 years of age is to be advanced to 28s. per week.

Suicide by Gas.—A verdict of "Suicide during temporary insanity" was returned at an inquest on the body of Miss Ada Mary Halfpenny, who was found in a house at Gorleston suffering from gas poisoning; her mother's dead body being also discovered in the house. Miss Halfpenny was found lying on the floor in the kitchen before an open gas-cooker, from which gas was pouring into the room; while upstairs her mother (aged 77) was dead on the floor with her head pressed into a pillow.

Sutton-in-Ashfield Gas Undertaking.—The Sutton-in-Ashfield District Council, at their meeting on Tuesday last, acceded to an application from a deputation representing employees at the gas-works for an increase in wages owing to increased cost of living, agreeing to give 1s. 6d. a week extra to those receiving over 30s., and 2s. to those who are paid 30s. or less. Mr. Briggs, one of the members, predicted that the gas undertaking would make no profit next year unless there was a great increase in price. It appeared to him that they would have to raise the price by at least 6d. per 1000 cubic feet.

Slough Gas Company.—It was stated in the report adopted at the meeting of the Slough Gas and Coke Company that the past half year had been satisfactory; and the Directors recommended a dividend at the rate of 6½ per cent. per annum on the ordinary stock and 5 per cent. per annum on the preference stock—both less income-tax. The Chairman (Mr. R. V. Elvey) pointed out that receipts from the sale of gas had increased by £487 over the corresponding half of the previous year, and this in spite of a reduction of 1d. in the price of gas. Unfortunately, however, the increased cost of coal had more than counterbalanced this gain.

Warrington Corporation and New Gas Plant.—At the last meeting of the Warrington Town Council, on the minutes of the Gas Committee coming up for confirmation, a discussion arose as to the necessity of having certain telpher machinery and other plant in operation for next winter. It was stated that, with the authority of the Committee, orders for the work had been given in anticipation of the Local Government Board sanction to the scheme. The Treasury would not at present approve of the issue of a loan for such purposes. The Town Clerk advised the Committee that they could make use of the special reserve fund in order to pay for the new plant, the cost of which was approximately put at £4600.

Nottingham's Diminished Gas Profits.—Nottingham ratepayers have been prepared for an announcement of considerably diminished profits upon this year's working of the gas undertaking. In view of lower consumption, largely increased cost of coal, and the state of the residuals market, the circumstances should not occasion any astonishment; but the ratepayers have for so long been accustomed to look to the gas revenue for substantial alleviation of local burdens that the change will to many come as an unpleasurable surprise. Under the excellent managerial *régime*, record results have been achieved. But obviously it is impossible, in view of existing conditions, that the highest level can be maintained; and if the temporary check should enforce an oft-repeated admonition regarding undue calls upon Nottingham's chief municipal trading concern, it may not be devoid of value.

Gas-Fitters and the Birmingham Gas Department.—Reference has already been made to the depletion of the Birmingham Gas Department's staff of workmen, in meeting the needs of the war material factories. In connection with this, a meeting of the Birmingham and District Master Gas-Fitters' Association has been held for the purpose of considering an invitation from the department to assist them in carrying on the work and protecting the interests of the consumers. The President (Mr. Charles Breeden) reported the result of conferences which the Committee had had with the leading officials of the department, and the following resolution was passed: "The members of the Association, having been informed of the call by the War Office on the staff of the Gas Department, undertake to do all in their power to assist the department in carrying out the work entrusted to them as promptly and as thoroughly as possible, not only during the summer months, but also during the winter, or as long as the war lasts." It was further resolved that the necessary details and working arrangements should be settled by the Committee of the Association in conjunction with the officials of the department.

Padiham Gas Profits Reduced.—At a meeting of the Padiham Town Council last week-end, Mr. Wiggins (the Chairman of the Finance Committee), in the course of a preliminary financial statement, said the amount estimated to be handed to the district fund, as on March 31, from the gas profits was £1482; but owing to exceptional circumstances, the actual profit available was only £135. Increased wages and higher cost of materials, together with lower yields from residuals, were said to be mainly responsible for the decrease.

Edward Medal for a Gas Employee.—The award of an Edward Medal of the Second-Class was announced in the "Gazette" last Friday for the following brave deed: On Oct. 1, 1914, John George Hinge was engaged with another man, at the Borstal Institution, Feltham, removing an obstruction in a gas-main. An explosion occurred, hurling Hinge out of the door of the building where they were working. The other man was thrown against the opposite wall, and his escape jeopardized by the flaming gas between him and the door. Hinge pluckily went to his rescue, and succeeded in helping him out. He then, though badly burned and nearly collapsing, took steps to cut off the gas, thereby preventing the possibility of further explosions.

War Bonus Granted at Wigan.—At a cost of £660 per year, and affecting 160 workers, the Wigan Town Council have decided to pay a war bonus of 2s. per week to all adult male employees of the Gas Department whose wages do not exceed 30s., of 1s. 6d. to those receiving between 30s. and 35s., and of 1s. to all male employees under 21 years of age. The question was raised with regard to employees at the gas-works who, by working seven days a week regularly, brought their wages over the 30s. rate, and in some cases over 35s. It was asked if these men could not have their wages assessed on a six-day week, so that they could come under the war bonus scheme. The Mayor replied that the Wages Board had already provided for this contingency.

Warrington Gas Prices Advanced.—At their monthly meeting last week, the Warrington Town Council, by a large majority, approved a recommendation of the Gas Committee to advance the price of gas, as from the 1st inst., from 2s. 7d. to 3s. per 1000 cubic feet. The amount is subject to a discount of 6d. per 1000 feet if the account is paid within one month. It was explained that the increase was necessitated by the higher prices of fuel and materials, and the granting of a war bonus to workmen and payment of allowances to the dependants of those who have joined the Colours. It was stated that the estimated extra costs work out as follows, as compared with the year ended the 31st ult.: War bonus, £1326; dependants' allowances, £1222; additional rates, £659; increased cost of coal £14,000 (less extra yield from coke, £7000), and cost of various other goods, £830; net total, £11,337.

GAS COMPANIES IN THE STOCK EXCHANGE.

The Stock Exchange has had another good week, bright and active, with firm markets "consolidating their position" (as the military phrase now is), and steadily advancing prices. There may perhaps be a tendency in some quarters to overdo the thing, and to act as if there were no rocks or pitfalls ahead to be calculated with, as if the shadow of peace could be descried through the mist of the future, and as if capital were not melting away at the rate of millions per day. If this be so, a great disillusioning is in store. Meanwhile, the pleased public crops the dainty food. In point of activity, anyhow, business progresses, and two "record" days were scored in the week. Points of interest were that, upon an issue of 15 millions of Treasury Bills, 44 millions were applied for; that Government now fixes the rates and invites tenders accordingly (an arrangement the Money Market seems to approve); that the Government have modified in favour of the Railway companies the arrangement made with them for apportioning the burden of the War bonus; and that the Stock Exchange Committee have relaxed their prohibition of arbitrage business. Thus it will be seen that there were some actual factors to cheer markets a bit. In the Gas Market, there was no conspicuous incident. Business was steady and normal. The aggregate of bargains was about level with what has now become the average, and recent prices were maintained generally. In the Money Market, easy conditions ruled almost up to the close, when an improved demand set in. Discount rates fluctuated; the later figures being easy.

Bargains done for cash during the week were as follows: On Monday, Gas Light ordinary 87½, 87⅝, ditto preference 86½, Oriental 111, South Suburban 100, 100½. On Tuesday, Gas Light ordinary 87½, 87⅝, 88, Oriental 111. On Wednesday, Alliance and Dublin *ex div.* 68¼, 69, British *ex div.* 40½, Gas Light ordinary 87½, 87⅝, 87⅞, ditto debenture 69½, 69¾, Primitiva preference 4⅛, 4 9/16, South Metropolitan 91½. On Thursday, British 40½, Commercial 3½ per cent. 95, Union 69, ditto preference 110, Gas Light debenture 69, 69½, Primitiva preference 4⅛, 4 9/16, South African 9, 9¼, 9⅜, South Metropolitan 92. On Friday, Aldershot preference 85½, 86, British 40, Union 70, Croydon 215, European 14, Gas Light ordinary 87½, 88. On Saturday, Alliance and Dublin 68¾, Gas Light maximum 69, ditto debenture 69¾.

Bank rate (fixed Aug. 8), 5 per cent.; last year, 3 per cent.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

WORKS SUPERINTENDENT. No. 6020.
COST ACCOUNTANT. Sheffield Water Department.
ENGINEER AND WORKS MANAGER. Yorktown and Blackwater Gas Company.
WORKING MANAGER. Somerton Gas-Works. Applications by April 30.
DRAUGHTSMAN. H. B. G., 109, Victoria Street, Westminster, S.W.
DRAUGHTSMAN. No. 6019.
WORKING FOREMAN (Geysers, &c.). No. 6021.
SALESMEN (Two). Portsea Island Gas Company. Applications by April 28.
CLERK-COLLECTOR. No. 6018.

Plant, &c. (Second-Hand), for Sale.

GAS-WORKS PLANT (various). Alloa Gas Department.

Patent Licences.

CARBIDE SUPPLY PISTONS. Haseltine, Lake, and Co., 28, Southampton Buildings, Chancery Lane, W.C.
TREATING COAL FOR COKING. Haseltine, Lake, and Co., 28, Southampton Buildings, Chancery Lane, W.C.

Sales of Stocks and Shares.

SOUTH ESSEX WATER COMPANY. London Mart. May 11.
SOUTHEND WATER COMPANY. By Tender. April 26.

TENDERS FOR

Coal.

CARLISLE GAS DEPARTMENT. Tenders by April 27.
SALFORD GAS DEPARTMENT. Tenders by April 29.

Lamps, &c.

CALCUTTA CORPORATION. Tender by Sept. 20.

Retort Setting.

LIMERICK GAS COMMITTEE. Tenders by April 26.

Middleton Corporation Gas Undertaking.—At the last monthly meeting of the Middleton Corporation, Alderman Townend (the Chairman of the Gas Committee), in moving the adoption of the minutes, said the Committee were not advancing the price of gas as were some neighbouring authorities. He hoped that the balance-sheet would be satisfactory, when it was presented.

Oswaldtwistle Gas Undertaking.—At the last meeting of the Oswaldtwistle Town Council, the Chairman of the Gas Committee (Mr. T. C. Usher) said that, despite the increased cost of coal and the lower selling prices of residuals, the gross profits of the Gas Department for the past twelve months were £3923, and the net profits £1255. Gas would remain at its present price. This satisfactory state of things reflected credit upon the Manager (Mr. J. H. Davies).

Increased Gas Prices in Ireland.—The Athlone Urban District Council have increased the price of gas (5s. 5d. per 1000 cubic feet) by 1s., in order to meet a deficit. The Limavady Urban Council have adopted the Lighting Committee's recommendation for an increase in the price of gas to 6s. 8d. per 1000 cubic feet. At a meeting of the Drogheda Corporation, the Gas Committee recommended an advance of 6d. per 1000 cubic feet in the price of gas; but the matter was adjourned, on the ground that the report had not been circulated among the members. The Committee calculated that coal freight would cost £1000 more during the next twelve months.

Burnley Lighting Restrictions.—In the Burnley Town Council, there have been strong complaints of the too-drastic plunging of the town into darkness. The lamps in the back streets are not now lit; and besides every second lamp being out in the main streets, the lamps are blackened three-parts of the way down, with the result that all the light secured from them is a few yards of the footpath. Mr. Irving said he had not come across a more dismal town at night. Other towns in the same military area were comparatively well lit, so that some one was interpreting the order too drastically. The Chairman of the Watch Committee pointed out that the matter was in the hands of the Chief Constable. It was suggested that, while such conditions prevailed, the Gas Committee might save expense by having only one mantle on a lamp instead of two; and thus, with a less intensified light, they might do with not so much blackening of the lamps. Alderman Emmott (the Chairman of the Gas Committee) promised that this suggestion should be considered.

The West Bromwich Town Council are releasing 92 of their employees for war work—17 from the Gas Department.

To take over certain mineral rights and the Brynna Colliery, &c., in Glamorganshire, the Brynna Gas Coal Collieries has been registered as a company with a capital of £25,000, in ordinary, cumulative preference, and deferred shares.

Some damage to the road was caused in Abertillery by a gas explosion, which blew a manhole cover into the air, but fortunately injured no one. It was supposed that, through a leak in the gas-main, there was an escape of gas into the sewer.

The Cahir (co. Tipperary) Gas Company having increased the price of gas to 6s. 6d. per 1000 cubic for lighting and 5s. 6d. for other purposes, it has been decided at a public meeting to start a company for the purpose of establishing electricity works.

The Burnley Corporation Gas Committee propose not to borrow money in future for lamps. For this, the Chairman explained to the Town Council, they only secured ten years for repayment of loans, and it was not worth going to the cost of an application. The idea was to take the money out of revenue, as it really made very little difference.

The Bradford Corporation Gas Committee have inaugurated a series of lectures and demonstrations in cooking by gas. Mr. J. H. Barraclough (the Chairman of the Committee) presided over the first lecture, which took place last week at the show rooms, when Miss Jennie Barker was the lecturer. Miss Barker remarked upon the regrettable fact that a great deal of prejudice, based upon experience of old types of gas appliances, still existed; and she drew attention to the vast difference between those types and the modern apparatus.

APPLICATIONS FOR LETTERS PATENT.

5163.—Jones, E., "Gas-turbines." April 6.
5192.—Autometrograph Akt.-Ges., "Printing-mechanism for counting-apparatus in meters." April 6.
5193.—Autometrograph Akt.-Ges., "Meters." April 6.
5198.—Symes, G. V., "Gas-economizing valves." A communication from the Fuel Economizer Company. April 6.
5300.—Jones, E., "Gas-turbines." April 6.
5266-7-8.—Carpenter, H. A., Warner, A. W., and the Riter-Conley Manufacturing Company, "Gas-generating apparatus." April 7.
5275.—Davis, H. N., and Twigg, W. R., "Gas cooking-stoves." April 7.
5305.—Ide, W., "Globes, and the like." April 8.
5315.—Glover, S., and West, J., "Gas-producers." April 8.
5316.—R. S. Stokvis and Zonen, Ltd., "Gas heating-apparatus." April 8.
5439-40.—Wilton, G., "Distillation of tar and debenzolizing wash oil." April 10.
5442.—Bickerton, H. N., "Gas-cleaning." April 10.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

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ROBERT DEMPSTER & SONS, Ltd., Contractors for Complete CARBONIZING PLANTS and every Description of GAS APPARATUS, ELEVATING, CONVEYING, and TELPHERAGE PLANTS, also STOKING MACHINERY, Rose Mount Ironworks, Elland.

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LEAK TEST,
The Best on the Market
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itch, Creosote, Brick and Fuel Oils, Benzol, Solvent Naphtha, Carbolic, Lysol, Sulphate of Ammonia.

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Supply
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Prices and Designs on Application to
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FOR Gas-Works Plant of Every Description; also SULPHATE OF AMMONIA and SULPHUR RECOVERY PLANTS.
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For Gas Retort and Furnace Repairs, &c.
(42nd Year of Sale).
Prices and Samples free on Application.
THE "PLUTONIC" CEMENT COMPANY,
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JOHN RILEY & SONS, Limited, Chemical Manufacturers, Hapton, near Accrington, are MAKERS of Special SULPHURIC ACID, for Sulphate of Ammonia Making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol, which has now been used for upwards of 50 years. References given to Gas Companies.

SULPHATE OF AMMONIA SATURATORS and all LEAD and TIMBER WORK in Connection with Sulphate Plants.
We Guarantee promptness with efficiency for Repairs.
Joseph Taylor and Co., Central Plumbing Works, Bolton.
Telegrams: "Saturators Bolton." Telephone 0848.

GAS PLANT for Sale—We can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
Firth Blakeley, Sons, and Company, Limited, Church Fenton, near Leeds.

J. E. C. LORD, Ship Canal Tar-Works, Weaste, Manchester. Pitch, Creosote, Benzols, Toluol, Naphtha, Pyridine, all kinds of Cresylic Acid, Carboli Acid, Sulphate of Ammonia, &c.

"GAZINE" (Registered in England and Abroad). A radical Solvent and Preventative of Naphthalene Deposits, and for the Automatic Cleaning of Mains and Services.
It is also used for the Enrichment of Gas.
Manufactured and Supplied by C. Bourne, West Moor Chemical Works, Killingworth, or through his Agents, F. J. Nicol & Co., Pilgrim House, Newcastle-on-Tyne.
Telegrams: "Doric," Newcastle-on-Tyne. National Telephone No. 2497.

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THE Burnden Tar Company (Bolton), Ld.
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PATENTS AND TRADE MARKS
PUBLICATIONS: "MERCHANDISE MARKS ACT, and Decisions thereunder," 1s.; "TRADE SECRETS v. PATENTS," 6d.; "DOCTRINE of EQUIVALENTS, Mechanical and Chemical," 6d.; "SUBJECT-MATTER of PATENTS," 6d.
MEWBURN, ELLIS, & PRYOR, Chartered Patent Agents, 70 & 72, Chancery Lane, London, W.C. Telegrams: "Patent London." Telephone: No. 243 Holborn.

GAS-MANTLES.—Dutch Factory can Undertake Large Contracts for Mantles of entirely Dutch Manufacture at Moderate Prices. Inquiries solicited.
Address, H. F. C. Richten and Co., 4, Hasseltschestraat, Scheveningen, Holland.

SITTINGBOURNE DISTRICT GAS COMPANY.

APPLICANTS for the Position of Secretary and ACCOUNTANT to the above Company who have not been Communicated with are THANKED for Applying, and are Hereby Notified that they are not Successful.

Robert Chapman,
Chairman.

Sittingbourne, April 17, 1915.

YORKTOWN AND BLACKWATER GAS COMPANY, CAMBERLEY, SURREY.

THE Directors invite Applications on Thursday, the 22nd of April, for the APPOINTMENT of ENGINEER and WORKS MANAGER.
Annual make, 100-Million cubic feet.
Applicants to state Salary required, and forward Applications to the Secretary.

SOMERTON, SOMERSET.

WANTED—a Working Manager (must be Capable Fitter) for 5-Million Works, Fuel, Light, and 30s. per Week, with small House on Works—Two Bedrooms only.
Applications to be sent on or before April 30, by letter only, with References, to J. S. Taylor, Secretary, Gas Company, Somerton.

DRAUGHTSMAN, Experienced in Gas-Works Plant, Wanted in London. Permanent Job for Good Man.
Apply, by letter, stating fully Experience, Age, and Salary required, to No. 6019, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

DRAUGHTSMAN, with Thorough Experience of Various Gas Plants, Design and Construction, required in Westminster Office to prepare Working Drawings unaided. Good Salary to Competent Gas Engineer.
Apply, "H.B.G.," 109, Victoria Street, Westminster, S.W.

PORTSEA ISLAND GASLIGHT COMPANY.

WANTED—Two Salesmen for the above Company's Chief Show-Rooms.
Candidates must have a Thorough Knowledge of all Appliances appertaining to Gas Lighting, Cooking, Heating, and Hot-Water Supply, Power, and Industrial purposes.
A Knowledge of Electricity would be considered an advantage.
Candidates must be of Good Address, and have been employed in a similar position with another Gas Company.
Age not to exceed 35. Married men preferred.
Apply, by letter only, stating Age and Salary required, enclosing *copies* of not more than Three Testimonials of recent date, addressed to the undersigned, not later than first post on Wednesday, April 28, 1915.

J. D. Ashworth,
Engineer and General Manager.

Hilsea Gas-Works,
Cosham, Hants.

SHEFFIELD CORPORATION.
(Water Department.)

EWDEN VALLEY RESERVOIR WORKS.

COST ACCOUNTANT.

COST Accountant, Thoroughly Qualified, with Practical Knowledge of Cost Accounts in Relation to Reservoir Construction on large public works, must have had Experience and have filled Responsible Position on similar works.
Apply, stating Age, Experience, and Salary required, with *copies* of Three recent Testimonials.

Wm. Terrey,
General Manager.

Water Department, Town Hall,
Sheffield, April 15, 1915.

WORKS SUPERINTENDENT.

WANTED, by a Suburban Gas Company, a RESIDENT SUPERINTENDENT. Must be Well Trained and Thoroughly Experienced with the Control of Workmen, Modern Carbonizing Methods, Stoking Machinery, Coal and Coke Handling Plant, Electrical Generating Plant, and the Manufacture of Carburetted Water Gas.
Commencing Salary, £200 per Annum, with House, Coal, and Gas free.
Apply, by letter, stating Age and Qualifications, and enclosing *copies* of not more than Two recent Testimonials, to No. 6020, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

CLERK-COLLECTOR Wanted for Gas-Works in Hants, with some Experience in Slot-Collecting, Meter Index Reading, Keeping Rentals, and to make himself generally useful in Assisting Manager. Fidelity Guarantee for £200 required—Premium paid by Advertisers.
Apply, stating Age and Wages required, with References, to No. 6018, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

FOREMAN (Working) Wanted in Machine Shop. Preference given to one with Knowledge of Geysers and Circulators. Permanent Job. Good Prospects for suitable man. London District.
Apply, by letter, stating Wages required, and Qualifications, to No. 6021, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

PURIFIERS for Sale—Set of Four 10 feet square, 14 feet square, and 6 feet square. Luteless. Quick Sale. Cheap indeed to save Removal Home.
Firth Blakeley, Sons, and Co., Ltd., Church Fenton, Leeds.

SCRUBBERS—Tower Scrubbers, 5 ft. by 30 ft. and 6 ft. by 35 ft. 8-inch and 10-inch Kirkham WASHER-SCRUBBERS.
Firth Blakeley, Sons, and Co., Ltd., Church Fenton, Leeds.

GASHOLDERS—80,000 and 30,000 Feet Capacity. Columnless. Steel Tanks. Nearly new. Sold re-erected Half Price. Also others, 12,000 and 20,000 feet capacity. Exceptionally good.
Firth Blakeley, Sons, and Co., Ltd., Church Fenton, Leeds.

EXHAUSTERS—5000, 7000, 10,000, 15,000 feet per Hour and Larger, Direct Coupled to Horizontal STEAM-ENGINES. Three-Blade Type. Guaranteed. Over stocked. Cheap indeed. Room wanted.
Firth Blakeley, Sons, and Co., Ltd., Church Fenton, Leeds.

CORPORATION OF CALCUTTA.

NOTICE TO CONTRACTORS.

TENDERS are invited, in duplicate for the Supply of 70 High Power Low Pressure Inverted Incandescent GAS ARC LAMPS and Burners, complete with Harp Shaped Brackets for fixing to existing Lamp Columns.
The above Lamps are required complete with Burners, Globes, Mantles, and all other necessary parts, and must be of about 600-Candle Power.
Tenders must also include prices for Mantles and all other parts for maintenance.
Illustrations, with full measurements, and all other details of the Lamps quoted for, must be supplied by the Tenderers.
The earliest time for Delivery of the full quantity must be stated.
Tenders must include Delivery, Free of all Charges, at the Corporation Lighting Stores, Calcutta, including Insurance against Breakages.
War Risk Insurance and Extra Freight Charges (if any) must be quoted separately.
The Corporation do not bind themselves to accept the lowest or any Tender, and will be at liberty to accept the whole or part of a Tender.
Payment will be made when Delivery is accepted.
Tenders will be received by the Deputy-Chairman of the Corporation up to Two p.m. on Monday, Sept. 20, 1915, when they will be opened in the presence of such Tenderers as may be present. Each Tender must be enclosed in Sealed Cover, and superscribed, "Tender for Inverted Incandescent Gas Lamps and Brackets."
No Tender will be considered unless accompanied by a Remittance to the extent of 2½ per cent. on the Total Value of such Tender.
The rates offered by the Tenderers will be in force for the whole year.
Tenderers must abide by the rules in regard to Tenders in vogue in the Corporation.

C. C. Chatterjee,
Secretary to the Corporation.

Municipal Office, Calcutta,
March 25, 1915.